SELECTED

ESOURCESABSTRACTS



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SELECTED

WATER RESOURCES ABSTRACTS

'A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior



VOLUME 3, NUMBER 22 NOVEMBER 15, 1970

W70-09011 -- W70-09510

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several pianned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

FOREWORDiii

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

EQUIVALENCE OF ANOMALOUS WATER AND SILICIC ACID SOLUTIONS,

Australian National Univ., Canberra. Research School of Physical Sciences.

V. V. Morariu, R. Mills, and L. A. Woolf. Nature, Vol 227, No 5256, p 373-374, July 25, 1970. 2 p, 1 fig, 10 ref.

Descriptors: *Water structure, *Silica, *Gels, Water properties, Water chemistry, Molecular structure

Identifiers: Polywater, Anomalous water.

It is possible to prepare, without the intermediary of finely drawn capillaries, a silica solution which possesses most of the features commonly associated with anomalous water. All the features of anomalous water can be exactly reproduced by introducing a solution of silicic acid into the capillaries. Anomalous water and silicic acid solutions have many features in common. There is now a growing body of results which show that the existence of a true polymeric form of water is doubtful. (Knapp-USGS) W70-09125

A BONDING MODEL FOR ANOMALOUS WATER.

Princeton Univ., N.J. Dept. of Chemistry. Leland C. Allen. Nature, Vol 227, No 5256, p 372-373, July 25, 1970. 2 p, 1 fig, 8 ref.

Descriptors: *Water structure, *Hydrogen bonding, Water properties, Water chemistry, Molecular structure

Identifiers: Anomalous water, Polywater.

In anomalous water structure rings in three dimensions are proposed because they lower the energy of the relatively small, delocalized, covalent-like bonding and especially because of the large Madelung (ionic) energy which arises from the large oxygen-hydrogen charge separation. Four spin-up electrons at the corners of a tetrahedron and four spin-down electrons at the corners of an interpenetrating tetrahedron pointing the opposite way are arranged around each oxygen center. Planes of hexagons stack in the graphite-like pat-tern. The type of symmetric divalent hydrogen bonding under consideration here differs from the hydrogen bridges found in boron hydrides in that the end atoms are electron rich rather than electron deficient, and in this circumstance the bonding must compete with the well established conventional, asymmetric hydrogen bonding widely found for the electron rich, electro-negative atoms N, O and F. (Knapp-USGS)
W70-09126

1B. Aqueous Solutions and **Suspensions**

W70-09126

EQUIVALENCE OF ANOMALOUS WATER AND SILICIC ACID SOLUTIONS,
Australian National Univ., Canberra. Research School of Physical Sciences. For primary bibliographic entry see Field 01A. W70-09125

A BONDING MODEL FOR ANOMALOUS Princeton Univ., N.J. Dept. of Chemistry For primary bibliographic entry see Field 01A.

02. WATER CYCLE

2A. General

EFFECTS OF FOREST CLEAR-FELLING ON THE STORM HYDROGRAPH, Georgia Univ., Athens.

For primary bibliographic entry see Field 03B. W70-09117

PLANT COVER, RUNOFF, AND SEDIMENT YIELD RELATIONSHIPS ON MANCOS SHALE IN WESTERN COLORADO,

Geological Survey, Denver, Colo. For primary bibliographic entry see Field 02J. W70-09118

SUBBOTTOM PROFILING SYSTEMS, A STATE-OF-THE-ART SURVEY,

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

R. T. Saucier.

Sponsored by U.S. Army Engineer Division, Lower Mississippi Valley. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report S-70-1, April 1970. 44 p, 1 tab, 13 pl, 38 ref.

Descriptors: *Seismic studies, Geophysics, Channel morphology, *Streambeds.
Identifiers: *Acoustic profiling systems.

A literature survey, data sheets, discussions with manufacturers and users, and field tests were used to assess the current status of acoustic subbottom profiling systems. Emphasis was on establishing operating principles, methods of survey operation, inherent capabilities and limitations, environmental restrictions, and availability, particularly from the standpoint of conditions and problems in the Lower Mississippi Valley area in shallow, fresh to brackish water bodies. Acoustic profiling systems are classified according to the method by which the sound energy is produced; i.e., piezoelectric and magnetostrictive transducer pingers, electromechanical-type transducers or boomers, sparkers and arcers, gas guns, air guns, and others. Either transducers or hydrophones are used to detect the reflecting acoustic signals. Operational considerations such as size and weight of equipment, and environmental considerations such as water depth were also taken into account. (Spivey-Waterways Experiment Station) W70-09176

DIGITAL ANALYSIS OF AREAL FLOW IN MULTIAQUIFER GROUNDWATER SYSTEMS: A QUASI THREE-DIMENSIONAL MODEL, Geological Survey, Washington, D. C. For primary bibliographic entry see Field 02F. W70-09197 W70-09197

ELEMENTS OF THE WATER BALANCE OF SMALL RESERVOIRS OF THE CENTRAL CHERNOZEM PROVINCES,

For primary bibliographic entry see Field 02H. W70-09314

ON THE SOLUTION OF INVERSE PROBLEMS IN HYDROGEOLOGY (FRENCH), SCET/Cooperation--BCA, Puteaux (France). For primary bibliographic entry see Field 02F.

ON THE SYSTEMS APPROACH IN HYDROLO-

Purdue Univ., Lafayette, Ind. Dept. of Aeronautics, Astronautics, and Engineering Sciences. Venkateswararao Vemuri, and Narasimhamurty

Bulletin International Association of Scientific Hydrology, Vol 15, No 2, p 17-38, June 1970. 22 p,

Descriptors: *Systems analysis, *Mathematical models, Hydrology, Operations research, Input-output analysis, Model studies, Data storage and retrieval, Simulation analysis, Digital computers, Linear programming, Dynamic programming, Computer programs.
Identifiers: Hydrologic systems.

A general theoretic framework for hydrologic systems research includes dynamical, structural, spatial and behavioral aspects of modeling with predictive powers. Many hydrologic problems can be effectively studied by systems analysis. The process of system modeling for large-scale, nonlinear, time-lag systems can be rationalized by suitably identifying and modeling subsystems. When computers are used as modeling tools methods of formulating the problem, choice of the computer used, and choice of performance criteria greatly influence the results. This in turn imposes certain limits on the validity of computer simulated models. These aspects are discussed by studying the nature of hydrologic systems and the nature of the associated inverse problems and requirements for validating the models. (Knapp-USGS) W70-09385

APPLICATION OF REGRESSION ANALYSIS IN HYDROLOGY,

Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch. For primary bibliographic entry see Field 07C. W70-09391

2B. Precipitation

INFLUENCE OF EVAPORATION FROM LAKE BAIKAL ON PRECIPITATION IN THE SURROUNDING REGIONS,

For primary bibliographic entry see Field 02D. W70-09096

MICROELEMENTS IN ATMOSPHERIC PRECIPITATION IN THE OTKAZNENSKIY RESERVOIR AREA, Nauchno Issledovatelskii Gidrokhimicheskii In-ATMOSPHERIC

Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).
G. S. Konovalov, and T. Kh. Kolesnikova.
Translated from Hydrochemical Materials (Gidrokhimicheskiye Materialy), Vol 49, p 74-80, 1969. Soviet Hydrology: Selected Papers, Issue No 2, p 166-170, 1969. 5 p, 1 tab, 15 ref.

Descriptors: *Trace elements, *Precipitation (Atmospheric), Chemistry of precipitation, Rainfall, Water chemistry, Water quality, Reservoirs. Identifiers: USSR, Otkaznenskiy Reservoir.

To determine the trace elements received by Otkaznenskiy Reservoir from precipitation, samples were collected and analyzed. The precipitation collector is installed 2 m above the reservoir dam. The lid of the collector is removed only during precipitation; thus the device collects mainly liquid precipitation. The solid particles that entered the precipitation. The solid particles that entered the sample were atmospheric dust falling during precipitation. Boron, fluorine, bromine and iodine were determined chemically in the precipitation samples. Vanadium, manganese, cobalt, nickel, copper, molybdenum, silver, tin, lead, iron, aluminum, titanium, and bismuth were determined by the chemical-spectral method. Some of the 17 elements studied were not found in the precipitation of the Otkaznenskiy Reservoir area (cobalt, molyb-denum, silver, tin, lead, and bismuth). The content of the other elements is high. This is associated with local conditions and attributable to the dry climate, scant vegetation, and wind action, which is responsible for the high dustiness of the atmosphere. (Knapp-USGS) W70-09099

Group 2B—Precipitation

GEOLOGICAL PAST,
Main Geophysical Observatory, Leningrad (USSR).
M. I. Budyko.

Translated from Bulletin of the USSR Academy of Sciences, Geographic Series (Izvestiya Akad. nauk SSSR, Ser. geograf.), No 1, p 5-16, 1969. Soviet Hydrology: Selected Papers, Issue No 2, p 183-192, 1969. 10 p, 6 fig, 24 ref.

Descriptors: *Pleistocene epoch, *Paleoclimatology, Climatology, Climates, Glaciers, Solar radiation, Dusts, Volcanoes, Humidity, Precipitation (Atmospheric), Synoptic analysis. Identifiers: USSR, Climatic change.

The main climatic characteristics of various geological epochs are determined quantitatively on the basis of a numerical model of the climatic regime as a function of external factors affecting the climate. It is found that the leading causes of the climate. It is found that the leading causes of the development of Quaternary ice ages were changes in the transparency of the earth's at-mosphere produced by volcanic activity, the uplift-ing of continents, and the narrowing of straits connecting the Arctic Ocean with oceans at low latitudes. (Knapp-USGS) W70-09102

INDIRECT METHOD FOR COMPUTING THE DURATION OF PRECIPITATION,

I. A. Aframeyeva.

1. A. Arrameyeva. Translated from Voyeykov Main Geophysical Ob-servatory (Trudy GGO), No 247, p 76-81, 1969. Soviet Hydrology: Selected Papers, Issue No 2, p 139-143, 1969. 5 p, 1 fig, 5 tab, 5 ref.

Descriptors: *Precipitation (Atmospheric), *Duration curves, *Time, Depth-area-duration analysis, Frequency, Statistical methods, Timing, Rainfall, Streamflow forecasting, Data collections. Identifiers: Europe, USSR, Precipitation duration.

A study was made of the duration of precipitation in Western Europe. Conversion factors make it possible to calculate the duration of precipitation by using the relationship between the number of days with and the actual duration of precipitation at any station in this region. The duration of at any station in this region. The duration of precipitation depends not only on the time of the year, but also on the physiographic conditions of a given region. Four regions are considered: (1) central part of Western Europe; (2) Scandinavia; (3) southeastern part of Western Europe; and (4) England and Ireland. Average conversion factors were computed for each of these regions and from them the average monthly total duration of precipitation was tabulated for the characteristic months of each season. (Knapp-USGS)

CHEMICAL COMPOSITION OF PRECIPITA-TION IN REGIONS OF THE SOVIET UNION, Main Geophysical Observatory, Leningrad

Main Geophysical Observatory, Leningrad (USSR).
O. P. Petrenchuk, and E. S. Selezneva.
Journal of Geophysical Research, Vol 75, No 18, p 3629-3634, June 20, 1970. 6 p, 1 fig, 7 tab, 17 ref.

Descriptors: *Air pollution, *Fallout, *Chemistry of precipitation, *Water chemistry, Nucleation, Precipitation (Atmospheric), Mineralogy, Solutes, Dusts, Sampling, Data collections, Path of pollu-Identifiers: *USSR.

The relative importance of the formation of droplets on condensation nuclei and the capture of contaminants by cloud and precipitation elements in various atmospheric layers, is evaluated. In the clean northern regions of the USSR the cloud contribution constitutes 55% of the total precipitation mineralization. In the southern regions, with heavy pollution of the atmospheric boundary layer, washout of pollutants in the subcloud layer is the predominant precess. Here the sloud extribution predominant process. Here the cloud contribution constitutes only 20-25%. Therefore, precipitation

plays a significant role in the self-cleaning of the atmosphere from admixtures of natural and artificial origin. (Knapp-USGS) W70-09133

CHEMICAL HYDROLOGY OF REGIONS OF

EAST ANTARCTICA, Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR). For primary bibliographic entry see Field 02K. W70-09134

A STUDY OF HEAT TRANSFER COEFFI-CIENTS IN THE LOWEST 400 METERS OF THE ATMOSPHERE,

New York Univ., Bronx. Dept. of Meteorology and Oceanography. Sharon S. Wu.

Journal of Geophysical Research, Vol. 70, No. 8, p 1801-1807, April 1965, 6 fig, 10 ref.

Descriptors: *Heat transfer, *Air temperature, *Heat flow, Turbulence, Advection, Winds, Boundary processes, Meteorological data, Anemometers, Density.
Identifiers: *Heat exchange coefficient, Steady

state, Diffusion coefficient.

The primary purpose of this study is to determine an appropriate formula for the turbulent heat exchange coefficient in the atmosphere. The heatexchange coefficient in the atmosphere. In eneat-transfer equation for the atmosphere is integrated numerically for a 24-hour period; various forms are assumed for the heat exchange coefficient KH, which does not explicitly include effects of windshear. The excess of energy in the lower layers in the experiments might be due to the exact form of KH used. Yet, the results are in reasonably good agreement with observation. The maximum error is about 1.5 deg K when the ratio KH/Km = r is 1 and a scaling height is made a function of the local potential temperature gradient where Km is the heat exchange coefficient taking into account the wind shear. However, since the temperature at 2400 minus the temperature at 0000 is not the same at all heights, there is perhaps significant advection or a significant height gradient of advection present. This involves a process occurring in nature which is not described by the equation employed. (Osborne-Vanderbilt) W70-09156

TURBULENT DIFFUSION IN A STABLY STRATIFIED SHEAR LAYER,

Colorado State Univ., Fort Collins For primary bibliographic entry see Field 08B. W70-09173

CLIMATIC OSCILLATIONS 1200-2000 A D, Copenhagen Univ. (Denmark). H. C. Orsted Inst.; and Army Terrestrial Sciences Center, Hanover,

N.H. S. J. Johnsen, W. Dansgaard, H. B. Clausen, and C.

C. Langway. Nature, Vol 227, No 5257, p 482-483, August 1, 1970. 2 p, 2 fig, 14 ref.

Descriptors: *Paleoclimatology, *Arctic, Glaciers, Ice, Sampling, Stable isotopes.
Identifiers: Greenland.

Using the isotopic composition of glacier ice as a climatic indicator is based on the fact that the concentration of heavy stable isotopes (deuterium and oxygen-18) in high polar snow increases with the temperature of formation of the snow. A unique constitution of the snow and configuration of the snow o temperature of formation of the snow. A unique possibility for studying palaeoclimates was offered when the US Army Cold Region Research and Engineering Laboratory succeeded in recovering a 1,400 meter long surface-to-bottom ice core from Camp Century on the North Greenland ice sheet. The stable isotope technique applied on the deep ice core gave an unbroken and detailed climatic record spanning probably 100,000 years. This paper presents the results of a detailed study of the ice which accumulated during the last 800 years (Knapp-USGS) W70-09224

STRONTIUM 90 CONCENTRATIONS IN SUR FACE AIR: NORTH AMERICA VERSUS AT LANTIC OCEAN FROM 1966 TO 1969, New York Operations Office (AEC), N.Y. Healtl

and Safety Lab. Peter C. Freudenthal.

Journal of Geophysical Research, Vol 75, No 21, 4089-4096, July 20, 1970. 8 p, 5 fig, 2 tab, 14 ref.

Descriptors: *Fallout, *Strontium radioisotopes Aerosols, Atmosphere, Pollutants, Precipitation (Atmospheric), Atmospheric physics, Meteorolo gy, Atlantic Ocean. Identifiers: North America.

Strontium 90 in surface air has been measured continually for three years, February 1966 to January 1969, at four North Atlantic Ocean weather sta tions to compare fallout processes over the ocean with those over land. Between 35 deg N and 55 deg N, concentrations over land were an average 1.1 times greater than those over the ocean. The relative concentration varied with both season and latitude, being greater in the north and during the summer. This variation seems to correlate better with monsoonal meteorological processes than with the suggested process of aerosol scavenging by ocean spray. (Knapp-USGS) W70-09229

WATER VAPOR BALANCE OF THE AT-MOSPHERE FROM FIVE YEARS OF HEMI-SPHERIC DATA,

Massachusetts Inst. of Tech., Cambridge. Dept. of Technology. Jose P. Peixoto.

Nordic Hydrology, Vol 1, No 2, p 120-138, 1970. 19 p, 6 fig, 25 ref. NSF Grant No GA-1310X.

Descriptors: *Water balance, *Climatology *Synoptic analysis, *Climatic data, Hydrologic cy-Cle, Data processing, Mapping, Topography Weather data, Automation, Charts, Data collections, Maps, Networks, Surveys, Synthesis Weather forecasting.

Identifiers: Atmospheric water vapor balance.

The atmospheric balance of water vapor for the northern hemisphere was investigated through entirely automatic data processing and objective analysis procedures, to assess the potentialities of these methods by examining a large sample of results The study was based on five years of daily observations taken at about 800 meteorological stations The final maps of the distribution fields of mean precipitable water content and of zonal and meridional transports of water vapor in the at-mosphere are presented and discussed. The structure and the implications of the water vapor divergence map for hydrology are treated. Finally the water vapor balance on a planetary scale is discussed and the results are compared with evidence obtained from climatological and hydrological sources. The five-year averages of the various fields appear to give consistent results and mainly agree with previous findings. The areas of highest water vapor content are shown over the equatorial regions of South America, eastern and western Pacific, the Indian Ocean, and equatoria West Africa. The region of lowest precipitable water is found over the Arctic. (Knapp-USGS) W70-09238

SOIL MOISTURE PRESSURE IN SOME CLI MATIC ZONES

Institut Prikladnoi Geofiziki, Leningrad (USSR). For primary bibliographic entry see Field 02G. W70-09291

Snow, Ice, and Frost—Group 2C

INFILTRATION IN TERMS OF SOIL MOISTURE, RAIN INTENSITY AND DEPTH OF

RAINFALL, Hungarian Univ. of Agricultural Sciences, Godollo

For primary bibliographic entry see Field 02G. W70-09301

A SELECTED ANNOTATED BIBLIOGRAPHY OF ENVIRONMENTAL STUDIES OF POLAND,

Air Force Environmental Technical Applications Center.

Alvin L. Smith, Jr. ETAC Technical Note 70-6, June, 1970. 53 p, 153

Descriptors: *Climatology, *Environmental effects, Meteorology, *Precipitation (Atmospheric), Hydrology, *Air temperature, Temperature, En-

Identifiers: Mesoclimatology, Poland.

This bibliography contains 153 references to environmental studies (1960-1969) concerning the Polish Peoples Republic (POLAND). Forty-three of the items referenced translations of Polish articles and are placed separately in the text. Five previously published bibliographies on the same area are also referenced. Entries are entered alphabetically by author and a Subject Index is included. W70-09456

2C. Snow, Ice, and Frost

METHODS OF COMPUTING MAXIMUM SOIL FREEZING DEPTH,

M. V. Zavarina.

Translated from Voyeykov Main Geophysical Observatory (Trudy GGO), No 246, p 73-82, 1969. Soviet Hydrology: Selected Papers, Issue No 2, p 131-139, 1969. 9 p, 3 fig, 1 tab, 11 ref.

Descriptors: *Frost, *Frozen soils, *Forecasting, Planning, Construction, Freezing, Melting, Synoptic analysis, Surveys, Frequency analysis, Probability, Climatology, Mapping, Data collections, Climatology, Mapping, Climatology, M matic data.

Identifiers: Frost forecasting, USSR.

The Hydrometeorological Service of the USSR has collected extensive observational data on soil temperature at various depths. From the long-period records it is now possible to construct curves of the integral frequency of various air temperatures or soil freezing depths and to determine values of given integral probability. Nomograms are given for computing freezing depths and probabilities under natural cover. Depth of freezing under bare soil was determined at only a few stations; therefore, there is more uncertainty in frost forecasting in urban areas than in the vegetated areas. (Knapp-USGS) W70-09104

AN ANALYSIS OF ICE LENS FORMATION, Army Terrestrial Sciences Center, Hanover, N.H. Shunsuke Takagi.

Water Resources Research, Vol 6, No 3, p 736-749, June 1970. 14 p, 3 fig, 1 tab, 39 ref.

Descriptors: *Frost, *Freezing, *Frost heaving, Frost action, Frozen ground, Ice, Soil water movement, Heat transfer, Mass transfer, Mathematical models, Mathematical studies, Adsorption. Identifiers: Ice lenses (Frost).

A mechanism of ice lens formation is based on the assumption that its main cause is the simulataneous flow of heat and water. The differential equations thus formulated are solved approximately by the use of a generalization of Goodman's integral method. The result is not completely satisfactory when compared with an execution. when compared with an experiment. The existence of a solution to the differential equations of ice lens

formation is demonstrated. The solution exists for a very narrow range of initial water content determined by the amount of surcharge on the ice lens. The narrowness of the range probably accounts for the observed intermittence of lenses. The Goodman technique or any generalization of it cannot yield a satisfactory solution of the problem. A simplification of Portnov's method has been found. With development of the mathematical method, improvements in the assumed mechanism, and refinements in the measurements of soil properties, we may be able to completely formulate frost heaving and thereby solve a long-standing problem. (Knapp-USGS) W70-09114

CHEMICAL HYDROLOGY OF REGIONS OF

EAST ANTARCTICA, Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).

For primary bibliographic entry see Field 02K. W70-09134

CLIMATIC OSCILLATIONS 1200-2000 A D,

Copenhagen Univ. (Denmark). H. C. Orsted Inst.; and Army Terrestrial Sciences Center, Hanover,

For primary bibliographic entry see Field 02B. W70-09224

MEASUREMENT OF THE THERMAL CON-DUCTIVITY OF FROST BY A TRANSIENT HOT-WIRE TECHNIQUE,

North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.

Journal of Geophysical Research, Vol 75, No 21, p 4180-4183, July 20, 1970. 4 p, 3 fig, 8 ref.

Descriptors: *Frost, *Frozen ground, *Instrumen-Descriptors: "Flost, Those ground, tation, "Thermal conductivity, Thermometers, Soil physical properties, Geothermal studies, Heat flow. Identifiers: Hot-wire thermometers.

A transient method of measuring thermal conductivity is described, along with the results of some experiments with frost. The method utilized a fine wire thermojunction, which is imbedded in the frost and heated at a constant rate with a radio frequency current. The transient temperature response of the wire is then obtained by electronic filtering and is related to the thermal properties of the frost by the theory of heat conduction from a line heat source in an infinite medium. The technique was found to work well with frost and is believed to provide a means of making the rapid and local measurements that are necessary for nonhomogeneous and transient media. (Knapp-USGS) W70-09233

PUMPING TESTS AND HYDROGEOLOGICAL INVESTIGATIONS OF AN ART AQUIFER NEAR HORSENS, DENMARK, Geological Survey of Denmark, Copenhage For primary bibliographic entry see Field 02F. W70-09237

CHARACTERISTICS OF PERMAFROST AND OF THE ACTIVE LAYER IN WEST SIBERIA,

N. A. Shpolyanskaya.

Translated from Herald of Moscow State University, Geographic Series (Vestnik MGU, ser. geogr.), No 3, p 88-94, 1969. Soviet Hydrology: Selected Papers, Issue No 2, p 195-200, 1969. 6 p, 2 fig, 2

Descriptors: *Permafrost, *Arctic, *Tundra, Frozen soils, Frozen ground, Mapping, Surveys, Soil types, Cold regions, Ice, Soil properties, Climatology, Paleoclimatology, Pleistocene epoch. Identifiers: *USSR, *West Siberia.

The distribution and temperature of present-day permafrost in West Siberia are determined by two

major factors: first, the present climate and heat exchange between the soil surface and the atmosphere, and, second, the evolution of permafrost in the Quaternary. The history of permafrost in West Siberia is peculiar in that the permafrost partly thawed from the surface during the Holocene, stopped thawing, and then the rocks froze again. Three large regions formed as a result of this freezing that differ in the ratio of layers of recent and old permafrost. These are the region of continuous recent and old (relict)permafrost, the region of scattered permafrost, and the region of old, deep-seated permafrost. Each of these regions is subdivided into geothermal zones that differ in the temperature, thickness, and spatial ratio of thawed and frozen rocks. They show distinct zonality, determined by the corresponding distribution of present physiographic conditions in West Siberia. (Knapp-USGS) W70-09257

PREPARATORY REPORT OF THE TECHNI-

CAL SUBCOMMITTEE ON SNOW.
Ministry of Works, Wellington (New Zealand).
Water and Soil Div.

New Zealand National Committee for the International Hydrological Decade, Ministry of Works, Wellington, 1969. 19 p, 1 fig, 1 tab.

Descriptors: *Snow surveys, *Runoff forecasting, Foreign research, Snowpacks, Snow management, International Hydrological decade, Planning, Water resources development.
Identifiers: *New Zealand.

The New Zealand Electricity Department was particularly interested in the quantity of water stored as annual snow and released during spring and summer. If forecasts could be made, considerable economies would be possible in the storage provided in reservoirs. Forecasts would also be of value for irrigation and for flood mitigation. (Knapp-USGS) W70-09351

EXPERIENCES WITH SNOW PILLOWS IN

NORWAY, Norwegian Water Resources and Electricity Board,

Arne Tollan.

Bulletin International Association of Scientific Hydrology, Vol 15, No 2, p 113-120, June 1970. 8 p, 6 fig, 6 ref.

Descriptors: *Snow surveys, *Precipitation gages, *International Hydrological Decade, Snowmelt, Snowpacks, Streamflow forecasting, Snow management, Water yield, Gaging stations, Data collec-

Identifiers: Snow pillows, Norway.

Snow pillows have been in use since 1961-62 in the USA and a great number of snow pillows are now in operation in USA and Canada. From the winter 1967-68 a snow pillow has been in operation in the representative basin Filefjell in Norway. Two additional pillows were installed during the winter 1968-69 in the representative basins Romerike and Sagelva. This report summarizes experience with snow pillows in Filefiell and Romerike as a part of the program conducted by the Norwegian national committee for the IHD. Snow pillows have proved to be a powerful tool in the study of reliability of conventional precipitation measurements, particularly in mountain areas. Combined with measurements of snowmelt run-off, pillow records may also throw light on the question of evaporation from snow cover. Pillow sites should be selected near existing meteorological stations, or be equipped with a certain minimum of meteorological instruments like precipitation gage, thermograph and anemometer. When reliable and sufficient observa-tions are available, pillow records can be used to study melt water formation as a function of climatic parameters. If the purpose of the pillow is flood forecasting or prognosis of inflow to reservoirs, it is

Group 2C-Snow, Ice, and Frost

of utmost importance to choose representative sites, based on extensive field surveying. (Knapp-USGS) W70-09375

FREEZING AND THAWING EFFECTS ON DRAINAGE,

Agricultural Research Service, Burlington, Vt. Soil and Water Conservation Research Div. For primary bibliographic entry see Field 02G. W70-09380

GEOPHYSICAL STUDIES IN PERMAFROST

REGIONS IN THE U.S.S.R., Moscow State Univ. (USSR). Dept. of Geophysics. For primary bibliographic entry see Field 07B.

THE PHYSICS OF GLACIERS.

Commonwealth and International Library of Science Technology, Engineering and Liberal Studies, Ottawa (Ontario). W. S. B. Paterson.

London, Pergamon Press, Ltd, 1969, 250 p.

Descriptors: *Glaciers, *Flow, *Ice, *Rheology, Freezing, Melting, Snow, Mechanical properties, Plasticity, Viscosity, Physical properties, Mathematical studies.

Identifiers: Glacier physics.

The physical principles underlying the behaviour of glaciers and ice sheets are explained, as far as they are understood at the present time. While the book is intended primarily for those starting research in the subject, established workers in glacier studies and in related fields should find it useful. The treatment is at about the graduate student level. The approach of the test emphasizes physics combined where necessary with mathematics. Mathematical physicists who may seldom set foot on a glacier, have contributed greatly to the understanding of the subject. In glaciology, as in other branches of science, both the theoretical and the experimental approach should be coordinated; the experiments should be designed to investigate specific problems. (Knapp-USGS) W70-09412

2D. Evaporation and Transpiration

INFLUENCE OF EVAPORATION FROM LAKE

INFLUENCE OF EVAPORATION FROM LAKE BAIKAL ON PRECIPITATION IN THE SUR-ROUNDING REGIONS, V.I. Korniyenko.

Translated from Voyeykov Main Geophysical Observatory (Trudy GGO), No 147, p 122-127, 1969. Soviet Hydrology: Selected Papers, Issue No 2, p 144-148, 1969. 5 p, 2 fig, 3 tab, 2 ref.

Descriptors: *Evaporation, *Lakes, *Precipitation Atmospheric), *Climatology, Rainfall disposition, Humidity, Water balance, Winds, Weather, Weather patterns. Identifiers: *USSR, *Lake Baikal.

Lake Baikal, a large (31,500 sq km) deep-water mountain lake, has a cooling effect on the adjoining regions in summer and a warming effect in winter. The temperature difference between the water surface and the air is 13-15 deg C in December. Owing to the orographic characteristics of the lake shore, this influence cannot reach far beyond the limits of watersheds. The effect of evaporation from Lake Baikal on precipitation in the surrounding regions was computed for the ice-free period from May to December for two years: 1963 with precipitation below normal, and 1965 with precipitation above normal. The contribution of evaporation from the lake to the change in moisture content is extremely small or nonexistent in summer. The influence of evaporation from Lake Baikal is strongest on the southeast shore in November-December when evaporation is strong and the moisture content of

the air is extremely low. The maximum station increase in precipitation is within 3-5% in October, 13-16% in November, and 10-15% in December. (Knapp-USGS) W70-09096

AN ENERGY BUDGET STUDY ABOVE THE FOREST CANOPY AT MARMOT CREEK, AL-

BERTA, 1967, Meteorological Service of Canada, Calgary (Alberta).

D. Storr, J. Tomlain, H. F. Cork, and R. E. Munn. Water Resources Research, Vol 6, No 3, p 705-716, June 1970. 12 p, 12 fig, 3 tab, 17 ref.

Descriptors: *Evapotranspiration, *Energy budget, *Forests, Demonstration watersheds, Rainfall-ru-noff relationships, Solar radiation, Water balance, Convection, Heat transfer, Photosynthesis, Winds, Diffusivity. Identifiers: *Marmot Creek Mass transfer,

Experimental Watershed (Canada), Alberta (Canada).

For a 19-day period in July 1967, daily estimates of evapotranspiration were obtained from hourly calculations of the Bowen ratio above the forest canopy in the Marmot Creek Experimental Watershed, Alberta, Canada. The estimates ranged from 7.9 mm to 1.5 mm. The Bowen ratio was found to be very dependent on wind direction, sky condition, and basin aspect, (which was a significant factor). Although the area is unhomogeneous, the results appear reasonable when compared with other estimates of evapotranspiration. (Knapp-USGS) W70-09111

ENERGY RELATIONSHIPS IN THE DESIGN OF FLOATING COVERS FOR EVAPORATION REDUCTION.

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

Water Resources Research, Vol 6, No 3, p 717-727, June 1970. 11 p, 9 fig, 4 tab, 24 ref.

Descriptors: *Evaporation control, *Reservoir evaporation, Energy budget, Solar radiation, Heat transfer, Evaporation.
Identifiers: Floating covers (Reservoir).

A theoretical analysis of the energy balance equation for a partially covered body of water indicates that surface reflectance for solar radiation and infrared emittance are important properties to consider in designing covers for maximum efficiency in reducing evaporation. White materials satisfy the requirement that both these parameters be as large as possible. Experiments were conducted on insuas possible. Experiments were conducted on management of the lated evaporation tanks partially covered with foamed wax, lightweight concrete, white butyl rubber, and styrofoam. Several shapes and sizes were tested. The radiative properties of the cover were again noted to be important, and thin covers proved to be slightly more efficient than thick insulated covers. Evaporation reduction was proportional to the percent of surface area covered, the constant of proportionality depending upon the color and type of materials used. For the white, impermeable materials tested, the constant of proportionality was near unity. The reduction in evaporation was also highly correlated with the reduction in not rediction (Knapp 15(S)) in net radiation. (Knapp-USGS) W70-09112

WATER USE BY SALT CEDAR,

Geological Survey, Lubbock, Tex.; and Texas Tech Univ., Lubbock

T. E. A. van Hylckama. Water Resources Research, Vol 6, No 3, p 728-735, June 1970. 8 p, 6 fig, 4 tab, 10 ref.

Descriptors: *Evapotranspiration, *Consumptive use, *Tamarisk, Phreatophytes, Evapotranspiration control, Water conservation, Water yield improvement, Clear-cutting, Soil-water-plant relationships,

Identifiers: Phreatophyte control.

Six years of observations on water use by salt cedar. conducted in a battery of evapotranspirometers, on tanks, have shown that thinned out stands uses nearly as much water as control tanks if the water is of good quality. It is concluded that the method of making a vegetation survey and then extrapolating water use as measured in evapotranspirometers to a 100% density can lead to serious overestimation of water use. Thinning and cutting are ineffective methods of saving water. In cutoff stands, under favorable conditions, shoots can increase in length by as much as 5 cm per day. Only a few plants such as bamboo and cucumber are reported to grow faster than that. The assumption that phreatophytes always transpire at a potential rate is not sustained by the facts presented in this paper. When differences in depth to water as small as 1,5 to 2.1 meters and 2.1 to 2.7 meters affect the water use, it seems reasonable to conclude that with a water table at four meters for instance (a situation not unusual along dry river beds), salt cedar still may thrive but use comparatively little water, and the claims as to the quantity of water potentially saved by their eradication could well be overesti-mated. (Knapp-USGS) W70-09113

DISPOSAL OF BRINE BY SOLAR EVAPORATION: FIELD EXPERIMENTS,

New Mexico State Univ., University Park. C. G. Keyes, Jr., Narendra N. Gunaji, Jesse V. Lunsford, and William D. Loth.

Lunsford, and William D. Loth. For sale by Supt. of Documents, U.S. Government Printing Office, Wash., D.C. 20402-Price \$1.50 per copy. Office of Saline Water Research and Development Progress Report No. 563, May 1970. 166 p, 15 tab, 15 fig, 36 ref, 7 append. OSW Contract No. 14-01-0001-969.

Descriptors: *Brine disposal, *Evaporation, *Energy balance, *Evaporation pans, Solar evaporation. Identifiers: Evaporation enhancement, Efficient dye, Evaporation ponds, Evaporation computer,

Field studies on the determination of evaporation of brine by methods of energy budget, water budget and mass transfer are described. Experiments were performed using insulated pans and ponds at both the Roswell, N. M. Test Facility and the New Mex-ico State University. Although the use of Naphthol Green enhanced the evaporation rate, the costs for evaporation decrease with increasing plant capacity; however the lowest unit cost for desalted water, and waste disposal by evaporation, is at a capacity of 75 MGD. (Rinne-Office of Saline Water) W70-09150

A DIURNAL DISTRIBUTION FUNCTION FOR DAILY EVAPORATION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey. P. M. Fleming.

Water Resources Research, Vol 6, No 3, p 937-942, June 1970. 6 p, 6 fig, 12 ref.

Descriptors: *Mathematical models, *Water bescriptors: "Mathematical models, "water balance, "Evaporation, "Energy budget, "Solar radiation, Lysimeters, Statistical models, Evapotranspiration."
Identifiers: Daily evaporation patterns.

Some deterministic mathematical models of hydrologic processes require an approximate diurnal distribution of evaporation. The problem of estimating the diurnal distribution of evaporation estimating the durnal distribution of evaporation rates is examined when only total daily evaporation is given. Two cases are considered, clear days, and nondimensional distribution functions are developed for each case. Application of the distribution functions requires a knowledge of the time of sunrise and daylength. Operating rules to decide which distribution function to employ are given in terms of alternate data surphise house. given in terms of alternate data, sunshine hours, solar radiation, and daily evaporation. The prelimi-

Streamflow and Runoff—Group 2E

nary nature of the results is emphasized. (Knapp-USGS) W70-09205

MONTHLY MEAN SURFACE TEMPERATURES FOR LAKE ONTARIO AS DETERMINED BY AERIAL SURVEY,

Meteorological Service of Canada, Toronto (On-

For primary bibliographic entry see Field 02H.

W70-09206

TRANSPIRATION OF PONDEROSA PINE AND DOUGLAS FIR AFTER TREATMENT WITH PHENYLMERCURIC ACETATE,

Arizona Univ., Tucson. For primary bibliographic entry see Field 03B.

WATER TRANSPORT IN SOILS BY EVAPORA-

TION AND INFILTRATION,
Rothamsted Experimental Station, Harpenden (England). D. A. Rose.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 171-181, 1968. 11 p, 6 fig, 1 tab, 20 ref.

Descriptors: *Evaporation, *Soil moisture, *Soil water movement, Percolation, Moisture content, Field capacity, Mathematical studies, Humidity, Drying, Diffusion, Laboratory tests, On-site tests. Identifiers: Soil water evaporation.

The equation of vertical flow is adapted to describe the evaporation of water from, and the uptake of water by a deep uniform soil free from vegetation. The theory is examined by laboratory measurements on long columns of 0.5 - 1.0 mm aggregates of three soils from Rothamsted and Woburn. Evaporation from soils initially at a uniform moisture content--field capacity--decreases as the square root of time, and causes moisture profiles which differ for each soil. Drying diffusivities calculated from these profiles have an unusual shape, decreasing to a minimum and then increasing as the moisture content falls from field-capacity to airdryness. The uptake of water treated in the same way yields wetting diffusivities which also display a prominent minimum as moisture content increases from air-dryness to field capacity. (See also W70-09277) (Knapp-USGS) W70-09276

SOIL TEMPERATURE AND WATER CONTENT CHANGES DURING DRYING AS INFLUENCED BY CRACKS: A LABORATORY EXPERIMENT, lowa State Univ., Ames. For primary bibliographic entry see Field 02G. W70-09379

MAP OF EVAPORATION FROM SMALL RESERVOIRS OF THE CENTRAL CHERNOZEM PROVINCES,

L. F. Forsh.

Translated from Russian. In: Water Balance and Silting of Small Reservoirs in the Central Chernozem of the Russian Soviet Federal Socialist Republic; collection of papers translated for U S Agricultural Research Service p 144-165, 1967. 22 p, 7 fig, 4 tab, 10 ref.

Descriptors: *Evaporation, *Reservoirs, *Lakes, Pescriptors: *Evaporation, *Reservoirs, *Lakes, *Ponds, Chernozems, Mapping, Meteorological data, Limnology, Winds, Vapor pressure, Water temperature, Humidity, Seasonal, Air temperature, Statistical methods, Stations.

Identifiers: *USSR, Chernozem Provinces.

Data recorded at the small reservoirs and ponds of Kursk Province, USSR, during the summer months of 1956 to 1960, were analyzed and maps of the

monthly evaporations in the Central Chernozen Provinces were drawn. This type of evaporation map must be used only as a guide in obtaining values of surface evaporation from reservoirs in the Central Chernozem Provinces, since in every individual case the values shown on the maps are subject to local conditions. Moreover, the accuracy of calculation of evaporation by using the Forsh (1963) formula lies within a range of 10 percent. The coefficients for converting evaporation to the 3 and 20 percent frequency given in this paper are useful in practical application. (See also W70-09312) (Gabriel-USGS) W70-09413

2E. Streamflow and Runoff

RUNOFF SYNTHESIS FOR RAIN-ON-SNOW BASIN,

Corps of Engineers, Portland, Oreg. North Pacific Div.

James A. Anderson, and David M. Rockwood. 38th Annu Meet Western Snow Conf, Victoria, Can, Apr 1970. 21 p, 7 fig, 3 tab, 10 ref.

Descriptors: *Watersheds (Basins), Streamflow, *Synthesis, *Synthetic hydrology, Runoff, Rainfallrunoff relationships, *Snowmelt, Hydrology, Snow-packs, Precipitation (Atmospheric), Rainfall. Identifiers: *SSARR (Acronym), *Hydrologic models, Willamette River Basin, Oreg.

The hydrologic elements and resulting computed runoff for the Willamette Basin Snow Laboratory in Oregon, for 1949-50 and 1050-51, were synthesized using the SSARR (streamflow synthesis and reservoir regulation) model. Results show that the watershed model of the SSARR computer program, when operated in a zonal mode, can adequately represent all hydrologic factors. The program can synthesize streamflow on a continuous basis for rain-on-snow basins, affecting runoff in a completely general manner, and can maintain continuity of the snowpack accumulation and melt throughout winter and spring. The program also can differentiate between the varying conditions of runoff and snowpack on an elevation basis. This is accomplished by subdividing a drainage basin into bands or zones of equal elevation, for which runoff conditions and streamflow conditions are computed individually. (USBR) W70-09027

EFFECTS OF FOREST CLEAR-FELLING ON THE STORM HYDROGRAPH,

Georgia Univ., Athens.
For primary bibliographic entry see Field 03B. w70-09117

RECONNAISSANCE OF WATER RESOURCES IN THE HAINES-PORT CHILKOOT AREA, ALASKA,

Geological Survey, Washington, D.C. James A. McConaghy.

Available free on request to the US Geological Survey, Wash, DC, 20242. US Geological Survey Circular 626, 1970. 16 p, 5 fig, 3 tab, 11 ref.

Descriptors: *Water resources, *Alaska, Water supply, Cities, Surface waters, Groundwater, Water yield, Water quality, Water wells, Water resources development.

Identifiers: Haines (Alaska), Port Chilkoot (Alaska).

The most obvious source of fresh water in the Haines-Port Chilkoot area of Alaska is the Chilkat River. It is nearby, has a dependable flow, and generally has satisfactory chemical quality; how-ever, the river contains glacial flour or suspended ever, the river contains glacial hour or suspended silt that causes a milky appearance and which is dif-ficult to remove. Creeks in the area do not have adequate water for dependable public supply. Groundwater is the best source of additional water in the area. There are few wells in the area and con-

sequently groundwater data were sparse. Exploratory auger drilling was the principal method used to obtain new groundwater data. In addition, surfacewater supplies were inventoried and water samples were collected for chemical analysis. (Knapp-USGS)

W70-09130

HYDROLOGY OF THE UPPER MALAD RIVER BASIN, SOUTHEASTERN IDAHO,

Geological Survey, Washington, D.C. E. J. Pluhowski.

For sale by Superintendent of Documents, US Government Printing Office, Wash, DC 20402 -Price \$0.45 (paper cover). US Geological Survey Water - Supply Paper 1888, 1970. 89 p, 35 fig, 11

Descriptors: *Water resources, *Groundwater basins, *Watersheds (Basins), *Idaho, Groundwater, Surface waters, Water yield, Water balance, Water utilization, Irrigation water, Recharge, Discharge (Water), Floods, Rainfall-runoff relationships.

Identifiers: Malad River (Idaho).

The Malad Valley comprises 485 sq mi in the Basin and Range physiographic province. Relief is about 5,000 ft; the floor of the Malad Valley is at an average altitude of about 4,400 ft. The climate is semiarid throughout the Malad Valley and its principal tributary valleys; above 6,500 ft the climate is subburial. subhumid. Annual precipitation ranges from about 13 inches in the lower Malad Valley to more than 30 inches on the highest peaks of the Bannock and Malad ranges. Annual water yields in the project area range from about 0.8 inch in the lower Malad Valley to more than 19 inches on the high peaks north and east of Malad City. The mean annual water yield for the entire basin is 4 inches, or about 115,000 acre-feet. Evaporation is greatest in July when about 7 inches is lost from lakes, reservoirs, and waterlogged areas; losses from free-water surfaces may be as much as 38 inches annually. An extensive groundwater reservoir consisting of sand and gravel interbedded with relatively impermeable beds of silt and clay underlies much of the Malad Valley. On the basis of a water-balance analysis, underflow from the project area was estimated to be 28,000 acre-feet annually, surface-water outflow was 51,000 acre-feet, and transbasin imports were about 4,000 acre-feet. The total water yield is not sufficient to meet all the water needs of the basin. A comprehensive water-management plan is required to ensure optimal use of the water resource. (Knapp-USGS)
W70-09132

STREAM ORDER AS A MEASURE OF SAMPLE SOURCE UNCERTAINTY, South Carolina Univ., Columbia.

For primary bibliographic entry see Field 02J. W70-09202

TURBULENCE MEASUREMENTS NEAR THE FREE SURFACE OF AN OPEN CHANNEL FLOW, Illinois Univ., Urbana. E. R. Holley. Water Resources Research, Vol 6, No 3, p 960-

963, June 1970. 4 p, 3 fig, 6 ref.

Descriptors: *Open channel flow, *Turbulence, *Free surface, Instrumentation, Measurement, Anemometers, Current meters, Model studies, Hydraulic models, Flumes, Calibrations. Identifiers: Turbulence meters.

Turbulence spectrums were obtained from 0.006 inch to 1 inch below the free surface of an open channel flow with a depth of 6 inches and a mean velocity of 0.93 fps. No significant variation in the spectrums was observed for the different distances below the surface. The data tend to substantiate the presence of turbulence in the region which is sometimes and the different distances. times called the surface film in reaeration studies. (Knapp-USGS)

Group 2E—Streamflow and Runoff

W70-09208

CALIBRATION OF WALNUT GULCH SUPER-CRITICAL FLUMES,

Agricultural Research Service, Stillwater, Okla. Soil and Water Conservation Research Div. Wendell R. Gwinn.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY8, Paper 7479, p 1681-1689, August 1970. 9 p, 4 fig, 2 ref, append.

Descriptors: *Stream gages, *Stage-discharge relations, *Supercritical flow, *Flumes, Alluvial channels, Gaging stations, Model studies, Sediment transport, Flowmeters. Identifiers: Stream-gaging flumes.

A new supercritical measuring flume is being used to gage sediment-laden ephemeral flows in steep channels. The transition from the natural channel to the straight modified trapezoidal measuring section of the flume consists of a cylindroid surface. The flume is kept free of deposition by a V-shaped floor which slopes in the direction of the flow. The head is measured at the midpoint of the straight section. Ten of these concrete flumes have been in-stalled in the Walnut Gulch Watershed near Tombstone, Arizona. Eight of the flumes have already been calibrated with models in the laboratory. The largest has a bottom width of 120 ft and a capacity of about 26,000 cfs. This structure is the largest known precalibrated flume now in operation. The design of the flumes, the laboratory calibration data and some observations of their field operation are analyzed. (Knapp-USGS) W70-09218

DISPERSION PREDICTION FROM CURRENT

METERS, Ontario Water Resources Commission, Toronto. Water Quality Surveys Branch.
Mervyn D. Palmer, and J. Bryan Izatt

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY8, Paper 7464, p 1667-1680, August 1970. 14 p, 8 fig, 6 tab, 9 ref, append.

Descriptors: *Dispersion, *Diffusion, *Current meters, *Lake Erie, Forecasting, Hydraulics, Turbulence, Turbulent flow, Correlation analysis, Probability, Path of pollutants. Identifiers: Turbulence meters.

Two-dimensional dispersion plumes for the near shore area of Nanticoke on Lake Erie are predicted by applying turbulent diffusion concepts to recording current meter data. Eulerian integral time scales are found from autocorrelation coefficients, based on monthly data. Lagrangian integral space scales and one-dimensional diffusion coefficients may be predicted. Average monthly probability distributions are based on north-south and east-west diffusion coefficients. The prediction equation is an average of long and short time diffusion equations. Better dilution is found near the shore and parallel to it. It is assumed that vertical diffusion is negligible, that the Reynold's number is large, and that the effective diffusion coefficients are constant over long periods. (Knapp-USGS) W70-09219

FLOOD OF AUGUST 1969 IN VIRGINIA, Geological Survey, Richmond, Va. J. D. Camp, and E. M. Miller. US Geological Survey Open-file report, 1970. 120 p, 31 fig, 1 plate, 4 tab.

Descriptors: *Historic flood, *Virginia, *Hurricanes, *Cloudbursts, *Flood damage, Stage-discharge relations, Rainfall-runoff relationships, Precipitation (Atmospheric), Storm runoff, Water levels, Hydrographs, Landslides, Erosion, Sedimen-

Identifiers: Hurricane Camille (1969).

Hurricane Camille became a tropical depression and soaked central Virginia with up to 28 inches of rain during the night of August 19th and morning

of the 20th, 1969. The rains, flash floods, and raininduced landslides accompanying the storm's passage have been called the worst natural disaster ever to strike Virginia. Discharge of streams in the James, Potomac, Rappahannock, and York River basins exceeded previous known maximums. At Tye River near Lovingston the peak flood discharge was eight times the previous high during the 31 years of record. James River stations downstream from the Maury River recorded peak flows of greater than 100-year recurrence interval. As of Nov. 13, 1969, the State had counted 113 dead and 102 injured with 39 persons still missing. The total damage amounted to over \$116 million. This report provides hydrologic data needed for planning and design. The report includes a general description of the flood; precipitation information; sediment aspects of the flood; and records of stage and/or discharge for 105 sites. (Knapp-USGS)

WATER BUDGET OF UPPER KLAMATH LAKE SOUTHWESTERN OREGON,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02H. W70-09250

FLOODS IN IOWA,

Geological Survey, Iowa City, Iowa. Harlan H. Schwob.

In: Flood Plain Management - Iowa's Experience, Papers presented at Conference on Flood Plain Management, 6th Water Resources Design Conference, Jan 23-25, 1968, Iowa State University; published by Iowa State University Press, Ames, p 27-35, 1969, 9 p, 3 fig, 12 ref.

Descriptors: *Floods, *Iowa, *Rainfall-runoff relationships, Flood forecasting, Flood protection, Flood damage, Flood plains, Statistics, Statistical methods, Historic flood, Maximum probable flood. Identifiers: *Mean annual flood.

The greatest floods recorded in Iowa are listed, analyzed, and discussed. Multiple regression analysis was made of the flood data for lowa rivers. This resulted in the division of the state into two hydrologic regions, with a formula being developed for each region permitting the mean annual flood (MAF) to be computed. The variables include drainage area, stream slope, and for most of the state the normal annual precipitation. The mean annual flood is described quantitatively as the mean of the annual flood peak discharges that would be derived from a very long streamflow record. The use of the mean annual flood to help define outstanding flood discharges is an attempt to place the data for different areas of the state on a common basis. The flood data presented serve to point out the potential and the extent of major floods known to have occurred within Iowa. These data can be used to assist in planning programs for flood plain management. (See also W70-09253). (Knapp-USGS) W70-09254

COASTAL WETLANDS OF VIRGINIA-IN-TERIM REPORT, Virginia Inst of Marine Science, Gloucester Point.

For primary bibliographic entry see Field 02L.

A PROPOSED STREAMFLOW DATA PROGRAM FOR MAINE,

Geological Survey, Augusta, Maine. For primary bibliographic entry see Field 07A. W70-09353

A NOTE ON THE ESTIMATION OF THE PARAMETERS IN LOGARITHMIC STAGE-DISCHARGE RELATIONSHIPS WITH ESTI-MATES OF THEIR ERROR, C. Venetis.

Bulletin International Association of Scientifici Hydrology, Vol 15, No 2, p 105-111, June 1970. 7 p, 1 fig, 1 tab, 7 ref.

Descriptors: *Stage-discharge relations, *Statisti-i cal methods, *Estimating, Regression analysis,s Streamflow forecasting, Open channel flow, Chan-1 nel morphology, Discharge coefficients, Leasts squares method, Water levels. Identifiers: Graphic estimation methods.

Under certain assumptions the stage-discharge relationship of a channel cross-section can be approximated by a logarithmic relationship. Observational pairs of stage and discharge plotted on loglog paper often cluster around a straight line and this suggests that the assumptions involved are often approximately satisfied. In such cases the parameters of the logarithmic relationship are usually estimated graphically from the position and slope of the straight line on the log-log paper. In this paper principles and methods are outlined for the estimation of the parameters with estimates of their standard error, via regression analysis.
Because the water level of zero flows is usually one of the unknown parameters, the regression is nonlinear and least squares optimal estimates can be obtained by a step-by-step approximation. The variances of the parameter estimates can be obtained from the dispersion matrix of the joint distribution of the least squares estimators via the likelihood function. An estimate of the error in predictions of the discharge depending on the corresponding stage may be obtained. (Knapp-USGS) W70-09374

HYDROLOGICAL SERIES AS A BASIS FOR

WATER RESOURCES POLICY,
Technische Hochschule, Munich (West Germany). For primary bibliographic entry see Field 06A. W70-09387

TURBIDITY OF RIVERS AND ITS DISTRIBUTION IN THE CENTRAL CHERNOZEM TION IN PROVINCES.

For primary bibliographic entry see Field 02J. W70-09416

FLOOD SERIES FOR GAGED PENNSYLVANIA

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources. B. M. Reich.

paper copy, \$0.65 in microfiche. Institute for Research on Land and Water Resources, Research Publication No. 63, University Park, Pa., Dec. 1969. 83 p, 1 tab, 5 fig, 21 ref. OWRR Project A-016-PA (1).

Descriptors: *Stream gages, *Stream flow, *Water year, *Return flow, *Watershed management, Gaging stations, Pennsylvania, Flood forecasting, Frequency analysis, Social aspects. Identifiers: *Horizontal asymptote, *Gumbel paper, *Except outlier, Weibull formula, Extreme events, Flood frequency curve, Return period.

Modern analyses of flood records for 84 locations on Pennsylvania streams are presented for engineering practitioners to judge for fit to three mathematical curves. Extreme value plots report the greatest instantaneous peak discharge for each the greatest instantaneous peak discining to decide water year. Floods are arranged in order of magnitude for each watershed and plotted as points on extreme value paper. Exact locations to which the data apply are described. For each plot the following information is given: major river basin in which each stream is located, atteam name, area in square each stream is located, stream name, area in square miles of each topographic drainage basin, number of years of data available, mean of the annual series of years of data available, mean of the annual series of floods in cubic feet per second, standard deviation of the annual series in cfs, and coefficient of skewness of the logs (to base 10) of the annual series values. Practitioners are asked to judge the general trend of the observed flood curves and rate them as to fit for Gumbel lines, Log-Gumbel curves, or Log-Pearson Type III curves. Judgments as to whether a horizontal asymptote will ultimately be reached and also for except outliers are also requested. Questionnaires are included in the publication. Results from these questionnaires will be analyzed anonymously and submitted for publi-cation in a technical journal where hydrologists can express their opinions in printed discussions. (Sink-Penn State Univ) W70-09420

2F. Groundwater

PREDICTIONS OF RESERVOIR LEAKAGE,

Dames and Moore, San Francisco, Calif.

George D. Roberts.

Bull Assn Eng Geol, Vol 6, No 1, p 70-82, Spring 1969. 13 p, 3 fig, 5 ref.

Descriptors: *Reservoirs, Reservoir design, Reservoir construction, *Reservoir leakage, *Reservoir surveys, *Water table, Reconnaissance surveys, Engineering geology, Geologic investigations, Sub-Engineering geology, Geologic investigations, Subsurface investigations, Geologic mapping, Observation wells, Groundwater flow, Groundwater geology, Groundwater, Leakage, Hydrogeology, Dams. Identifiers: Reservoir modifications, Groundwater system, Norfork Dam (Ark), Clearwater Dam (Mo), Hawthorne Reservoir (Nev), Seepage control

A study of groundwater conditions within and adjacent to a proposed reservoir is an initial requirement of investigations for constructing a dam. Basic principles for a reservoir groundwater study are illustrated by case histories. The relationships between the natural groundwater level and leakage, and subsurface hydraulic effects caused by a reservoir are discussed. The groundwater survey should include map study; field reconnaissance; review of literature; and field measurements of water wells. Sow from surings chamical analysis. water wells, flow from springs, chemical analysis, and groundwater flow rates. The cost of a groundwater study is low and is an investment that yields a high return in terms of trouble and expenses avoided. Because of the usual initial slow rate of groundwater adjustment to new reservoirs, studies should continue during the first several years of reservoir operation to detect changes in water levels that could develop into leakage. (USBR) W70-09046

METHOD FOR COMPUTING GROUNDWATER LEVEL FLUCTUATIONS,

I. V. Vol'ftsun.

Translated from State Hydrologic Institute (Trudy GGI), No 165, p 128-147, 1969. Soviet Hydrology: Selected Papers, Issue No 2, p 115-130, 1969. 16 p, 7 fig, 4 tab, 2 ref. 3 append.

Descriptors: *Water level fluctuations, *Ground-water, *Water balance, *Hydrologic budget, Infiltration, Precipitation (Atmospheric), Recharge, Evapotranspiration, Discharge (Water), Ground-water movement, Water table, Surface-ground-water relationships.
Identifiers: Groundwater-level fluctuations.

A water balance method can be used to calculate groundwater-level fluctuations during the growing season. For coarse-texture soils and a groundwater season. For coarse-texture soils and a groundwater depth of about 1.5 m, when the seepage time of precipitation through the aeration zone is 1 day or less, when there is no backwater from rivers or lakes, and no water exchange between aquifers, the method of computation described can be used to precalculate the groundwater level one day in advance. It can also be used to predict fluctuations of flow over a long period preceding a given data flow over a long period preceding a given data, from precipitation, air moisture deficit, and wind speed data. It is possible to determine the effect of human activity, such as for example, the planting of forests, various agricultural practices, etc., on groundwater level regime and surface runoff in the catchment. (Knapp-USGS)

W70-09103

NUMERICAL MODELING OF UNSATURATED GROUNDWATER FLOW AND COMPARISON OF THE MODEL TO A FIELD EXPERIMENT,

Kansas Univ., Lawrence, and Geological Survey, Garden City, Kans.

Don W. Green, Hassan Dabiri, Charles F. Weinaug, and Robert Prill.

Water Resources Research, Vol 6, No 3, p 862-874, June 1970. 13 p, 13 fig, 2 tab, 19 ref. OWRR Project B-018-KAN.

Descriptors: *Groundwater movement, *Soil water movement, *Surface-groundwater relationships, *Unsaturated flow, *Mathematical models, Computer models, On-site tests, Wetting, Drying, Pit recharge, Ponds, Recharge, Percolation, Numerical analysis, Porous media.

Identifiers: 2-phase flow (Soil water).

A mathematical model describing isothermal, twophase flow in porous media consists of differential equations, using algorithms for their numerical solution. It was applied to the problem of vertical groundwater movement in unsaturated soils in the absence of evaporation and transpiration. The equations describing water-air flow through porous media are second order, nonlinear partial dif-ferential equations. These equations were converted to finite difference form and were solved with the aid of a digital computer using an iterative implicit procedure. The model includes effective permeabilities of each phase and capillary pressure as functions of liquid saturation. The properties of the porous media may be varied in the model as functions of position. A comparison was made between computed results and experimental field data on moisture movement beneath a shallow surface pond. Water was added to the pond at controlled rates to maintain an approximately constant head for a set time period. Following this wetting period the pond was kept dry, but covered to reduce evaporation. The experiment was simulated with the computer model and excellent agreement between calculated results and the data was obtained. (Knapp-USGS)
W70-09107

TWO-DIMENSIONAL DISPERSION EXPERIMENTS IN A POROUS MEDIUM, California Univ., Santa Barbara.

John C. Bruch, Jr. Water Resources Research, Vol 6, No 3, p 791-800, June 1970. 10 p, 7 fig, 1 tab, 9 ref.

Descriptors: *Dispersion, *Porous media, *Groundwater movement, Convection, Seepage, Mixing, Flow, Density, Viscosity, Model studies, Hydraulic models, Laboratory tests. Identifiers: Two-dimensional dispersion.

A series of two-dimensional dispersion experiments were performed in a one-and-two-layered porous medium. The experimental results were compared with a theoretical and a numerical solution both of which describe the two-dimensional dispersion of a miscible, second fluid through a unidirectional, seepage flow. The combined effect of longitudinal and lateral dispersion was considered in all cases. The experimental results and their comparisons with the numerical values clearly demonstrate the need to consider the combined effect of longitudinal and lateral dispersion in the analysis of the propagation of a miscible fluid in groundwater flow. If lateral dispersion were not considered, there would be no salt concentration at the position discussed. These, as well as the other results presented, also verify the use of the theoretical solution and the numerical scheme as accurate models for the two-dimensional dispersion phenomenon. (Knapp-USGS)

POST-IRRIGATION MOVEMENT OF SOIL WATER: 1. REDISTRIBUTION, Wisconsin Univ., Madison.
For primary bibliographic entry see Field 02G. W70-09124

THE PROTECTION OF GROUNDWATER RESOURCES.

National Water Well Association, Columbus, Ohio.

Water Well Journal, Vol 24, No 7, Special Issue, p 31-33, July 1970. 3 p.

Descriptors: *Water resources development, *Water management (Applied), *Water pollution sources, *Water pollution control, Water pollution treatment, Reviews, Surveys, Bibliographies, Publi-cations, Legislation, Water law. Identifiers: Groundwater resource protection.

Groundwater resources protection, development, pollution, and legislation are discussed in a comprehensive review article. The topics separately discussed include groundwater protection, ground-water availability, groundwater uses, classification of pollutants, surface pollution sources, pollution from production wells, pollution from injection wells, purification of polluted groundwater, state and federal legislation, and management. (Knapp and federal legislation, and management. (Knapp-USGS) W70-09127

RECONNAISSANCE OF WATER RESOURCES IN THE HAINES-PORT CHILKOOT AREA, ALASKA,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02E. W70-09130

HYDROLOGY OF THE UPPER MALAD RIVER BASIN, SOUTHEASTERN IDAHO, Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 02E. W70-09132

A NUMERICAL TECHNIQUE FOR CALCULATING THE TRANSIENT POSITION OF THE

SALTWATER FRONT, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02L. W70-09196

DIGITAL ANALYSIS OF AREAL FLOW IN MULTIAQUIFER GROUNDWATER SYSTEMS: A QUASI THREE-DIMENSIONAL MODEL,

Geological Survey, Washington, D. C. J. D. Bredehoeft, and G. F. Pinder. Water Resources Research, Vol 6, No 3, p 883-888, June 1970. 6 p, 5 fig, 11 ref.

Descriptors: *Groundwater movement, *Aquifers, *Mathematical models, Computer programs, Equations, Numerical analysis, Aquicludes, Leakage, Permeability, Artesian wells, Water storage, Water table.

Identifiers: Multiaquifer systems, Leaky artesian aquifers.

A general solution for the response of multiple aquifer systems to pumping stress requires solving the three-dimensional flow equations. The large number of arithmetic calculations and the excessions. sive computer storage required for a numerical solution usually precludes solving the equations in three dimensions for typical hydrologic problems. When the hydrologic system is represented by aquifers in which flow is assumed horizontal, and confining layers in which flow is assumed vertical, the problem can be reduced to solving two-dimen-sional equations for each aquifer, the aquifers being coupled through leakage. An iterative scheme is used to solve simultaneously the finite difference equations describing the response of confined and unconfined aquifers with or without storage in the confining layer. (Knapp-USGS) W70-09197

FINITE ELEMENT METHOD OF ANALYZING STEADY SEEPAGE WITH A FREE SURFACE,

California Univ., Berkeley.
For primary bibliographic entry see Field 02G.
W70-09198

Group 2F—Groundwater

A MOVING BOUNDARY MODEL OF A ONE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIENT POROUS FLOW SYSTEM,

Stanford Univ., Calif. For primary bibliographic entry see Field 02G.

IN ARTIFICIAL IMBIBITION GROUNDWATER REPLENISHMENT OF GROUNDWA THROUGH CRACKED POROUS MEDIUM, Maharaja Sayajirao Univ. of Baroda (India).

A. P. Verma. Water Resources Research, Vol 6, No 3, p 906-911, June 1970. 6 p, 3 fig, 20 ref.

Descriptors: *Groundwater movement, *Injection wells, *Mathematical models, *Mixing, Saline water intrusion, Porous media, Fractures (Geology), Permeability, Immiscibility, Viscosity, Water properties, Wettability, Wetting. Identifiers: Imbibition (Groundwater).

A theoretical model of groundwater replenishment in a cracked porous medium considers simultaneous occurrence of the phenomena of fingering and imbibition. Injection of water into other water bodies is initiated by imbibition, and the injected and native water form two immiscible liquid phases of different salinities with small viscosity difference. For the average behavior of fingering, the nonlinear differential equation is solved by a perturbation technique. An expression for the average cross-sectional area occupied by fingers was obtained (Knapp-USGS)
W70-09200

GROUNDWATER DISCHARGE IN THE IL-LINOIS BASIN AS SUGGESTED BY TEMPERA-TURE ANOMALIES,

Illinois State Geological Survey, Urbana. Keros Cartwright.

Water Resources Research, Vol 6, No 3, p 912-918, June 1970. 7 p, 6 fig, 1 tab, 23 ref.

Descriptors: *Groundwater movement, *Discharge (Water), *Illinois, *Geothermal studies, Borehole geophysics, Heat flow, Temperature, Thermal con-Recharge, Groundwater (Geology), Hydrologic budget, Fractures Hydrogeology. Identifiers: Illinois Basin.

Areas where groundwater in the illinois basin is moving vertically should be reflected by temperature anomalies. An isothermal map for a depth of 500 feet was constructed, based on bottom hole temperature of deep wells. This map was compared with a theoretical isothermal map for a depth of 500 feet that was made by projecting temperature gradients calculated from the thermal conductivities of the rock downward. The residual temperature map shows several warm and cool anomalies that are postulated to be discharge and recharge that are postulated to be discharge and recharge areas, respectively. Analysis of the curvature of the earth's thermal profile suggests that approximately 59,000 acre-feet of groundwater per year are discharged upward from the deep rocks in the Il-linois basin. This figure is of the same magnitude as an estimated excessive groundwater discharge into the region's streams of 43,000 acre-feet. From a simplified model of the basin, a groundwater inflow of about 36,500 acre-feet from the surrounding highlands is estimated. A significant portion of discharge must be through fracture zones associated with faults and anticlines. One discharge area in southwestern Illinois is also suggested by field data. (Knapp-USGS)

ELECTROLYTIC MODEL STUDY FOR COL-

LECTOR WELLS UNDER RIVER BEDS,
New Mexico Inst. of Mining and Technology,

Socorro. Bruce E. Debrine.

Water Resources Research, Vol 6, No 3, p 971-978, June 1970. 8 p, 7 fig, 11 ref.

Descriptors: *Induced infiltration, *Water yield, *Groundwater movement, *Surface-groundwater relationships, *Analog models, Alluvial channels, Discharge (Water), Flow, Model studies. Identifiers: Electrolytic models.

Analytical solutions of flow to collector wells are based on the assumption of uniform flux distribution along the laterals. Although theoretically the head, and not the flux, should be uniform, these solutions have been claimed closely to approximate the drawdown in the collector well. To test the validity of this claim, the flow to a well with a single lateral, located under a river bed and along which the head is maintained uniform, is reproduced by an electrolytic model. The results of this model study agree rather well with the solutions of Hantush and Papadopulos, the relative deviation being about 2.2%. It is concluded that these solutions adequately describe the drawdown in a collector The study further suggests that the flow to a collector well can be treated, using the assumption of either uniform flux or uniform head along the laterals. (Knapp-USGS) W70-09210

SUMMARY OF GROUNDWATER OCCURRENCE IN CALIFORNIA,

Geological Survey, Menlo Park, Calif.

U S Geological Survey Open-file report, March 17, 1970. 7 p, 1 map.

*Groundwater, *California. *Hydrogeology, *Reviews, Surveys, Aquifers, Water sources, Alluvium, Mapping, Maps, Hydrologic data, Water yield, Water quality, Geology.

In California most of the readily available ground-water that is pumped from wells occurs in Cenozoic nonmarine sedimentary rocks and alluvial deposits. These deposits fill most of the larger and many of the smaller structural basins. Brief statements are given to summarize groundwater occurrence for all the formations shown on the 'Geologic map of California.' (Knapp-USGS) W70-09214

WATER-LEVEL AND WATER-QUALITY TRENDS IN AQUIFERS ALONG THE MISSIS-SIPPI GULF COAST, 1970, Geological Survey, Jackson, Miss.

Donald E. Shattles, and James A. Callahan. U S Geological Survey open-file report, July 1970. 19 p, 7 fig, 4 tab, 10 ref.

Descriptors: *Groundwater, *Aquifers, *Fresh water, *Mississippi, *Water-level fluctuations, Water quality, Hydrographs, Artesian wells, Confined water, Saline water intrusion. Identifiers: Gulf coast, Water quality trend.

Artesian water levels along the Mississippi coast are declining 0.5 to 1.0 foot per year on the average; however, water levels are still above or only slightly below land surface in most places, and considerable additional drawdown is economically available. The groundwater is of good quality except in a few localities where the concentration of chloride exceeds 250 mg/liter. Of the 43 wells that were resampled during 1969, 18 showed a decrease in chloride, 18 showed an increase, and 7 indicated no change. (Lang-USGS)
W70-09223

COMMON ERRORS IN DEVELOPING A GROUNDWATER AQUIFER,

Geological Survey, Louisville, Ky. Water Resources Div.
D. V. Whitesides.
Groundwater, Vol 8, No 4, p 25-28, July-August

1970. 4 p, 8 fig.

Descriptors: *Water resources development, *Groundwater, *Kentucky, *Alluvial channels,

*Surface-groundwater relationships, Conjunctivi use, Induced infiltration, Ohio River, Aquifere Groundwater movement, Planning, Water manage ment (Applied). Identifiers: Groundwater development.

Some of the more common errors made in the development of groundwater supplies in the alluvi al aquifers along the Ohio River in Kentucky are discussed. Ample available literature on prope methods of development of the alluvial aquifers generally seems to have been ignored by the wate users in the area. The more common errors made in the typical developments are singled out for discuss sion. In the typical development the aquifer is treated as an inexhaustible underground rivers. Wells generally are clustered in small areas remotes from the Ohio River, and are likely to be located more for convenience and economy of pipeline or property access than for hydrologic considerations It is hoped by highlighting these errors and showing alternative methods of development that propen development practices will be fostered. Stages in the development of two hypothetical groundwaters aquifers in the Ohio River valley are shown by eight illustrations that stress the common errors made in development and alternative methods of development taking into account hydrologic considerations. (Knapp-USGS) W70-09225

AQUIFER SIMULATION ON SLOW TIME RE-SISTANCE-CAPACITANCE NETWORKS Birmingham Univ. (England). Dept. of Civil En-

Groundwater, Vol 8, No 4, p 15-24, July-August 1970. 10 p, 11 fig, 1 tab, 5 ref, append.

Descriptors: *Simulation analysis, *Analog models, *Groundwater movement, Analog computers, Computer models, Instrumentation, Computers, Model studies, Resistance networks. Identifiers: Slow-time analog models.

Resistance-capacitance networks are used to simulate aquifers; most reported work is concerned with fast time analogs in which the period under consideration is represented in microseconds. However the alternative slow time analog has many advantages since the electrical experiment takes several seconds. This results in simpler equipment and simpler experimental techniques. Practical aspects of the slow time analog are discussed, with details given of the components, of simulating wells and recharge, and of measuring instruments. The techniques are illustrated by a simplified example (Knapp-USGS)
W70-09226

GROUNDWATER VELOCITY PARTITION,

Montana State Univ., Bozeman. Dept. of Earth Darrel E. Dunn. Groundwater, Vol 8, No 4, p 14, July-August 1970.

Descriptors: *Groundwater movement, *Velocity, Transmissivity, Aquifers, Water levels, Water table, Recharge, Flow, Discharge (Water). Identifiers: Groundwater velocity.

The true velocity of groundwater at a point in the The true velocity of groundwater at a point in the groundwater system may be expressed as the sum of a number of partial velocities. Each partial velocity may be defined as a velocity which results from the presence of specific features of the configuration of the water table. Partial velocities may be used to facilitate the discussion of groundwater for the presence of the discussion of groundwater for the present of the flow systems and associated phenomena. (Knapp-USGS) W70-09227

PUMPING TESTS AND HYDROGEOLOGICAL INVESTIGATIONS OF AN ARTESIAN AQUIFER NEAR HORSENS, DENMARK, Geological Survey of Denmark, Copenhagen.

L. J. Andersen, and Z. Haman. Nordic Hydrology, Vol 1, No 2, p 69-110, 1970. 42 p, 10 fig, 13 tab, 14 ref.

Descriptors: *Aquifers, *Glacial drift, *Confined water, *Theis equation, Clays, Sands, Unsteady flow, Artesian wells, Drawdown, Groundwater movement, Permeability, Transmissivity. Identifiers: *Denmark, Jacobs equation, Aquifer

In the Egebjerg area, near Horsens, Denmark several aquifers consist of glacial outwash material in a glacial buried valley in the Tertiary formation. The lowest of these, which is the main productive aquifer, and which has leaky artesian conditions, varies in thickness from 10-40 m. The lower confining bed consists of boulder clay or meltwater clay underlain by boulder clay. The upper confining bed, where leakage occurs, consists of meltwater clay with thickness from 0 to 5 m. The upper melt-

water deposits include a sequence of interglacial lake deposits and several layers or laminae of clay, which separate this water-bearing material into more aquifers. The Theis modified non-equilibrium equation and its derived formula for the nonsteady-state leaky artesian case were used to determine aquiter properties from pumping test data. By means of Jacob's method and a logarithmic method, well characteristics are determined graphically. Barometric efficiency, reverse fluctuations, and boundary conditions are recorded and discussed. (Knapp-USGS)
W70-09237 mine aquifer properties from pumping test data. By

RECONNAISSANCE OF THE GROUNDWATER RESOURCES OF THE MISSOURI RIVER AL-LUVIUM BETWEEN MIAMI AND KANSAS

CITY, MISSOURI,
Geological Survey, Washington, D.C.
L. F. Emmett, and H. G. Jeffery.
For sale by US Geological Survey, Washington, DC
- Price \$0.50. US Geological Survey Hydrologic Investigations Atlas HA-344, 1 sheet, 1970. Text, 3 fig, 1 tab, 19 ref.

Descriptors: *Water resources, *Groundwater, *Alluvium, *Missouri River, *Missouri, Water wells, Aquifers, Water yield, Water quality, Water utilization, Water resources development. Identifiers: Missouri River alluvium.

The purpose of this 1-sheet hydrologic atlas is to describe the thickness, areal extent, and lithology of the alluvial deposits along the Missouri River between Miami and Kansas City, Mo., and to provide information on the occurrence, availability, use, and chemical quality of the water contained in the alluvial aquifer. Flood-plain width varies from 2 to 10 miles and has a total surface area of approxito 10 miles and has a total surface area of approximately 440 square miles. Underlying the flood plain are clay, silt, sand, and gravel deposited by the river. The saturated sand and gravel, which is hydraulically connected with the river, constitutes a large and productive aquifer, which for the most a large and productive aquiter, which for the most part is presently underdeveloped. Eleven cities pump approximately 13.6 million gallons of water per day from the alluvial aquifer in this reach of the river. Industrial use of groundwater is confined to the Kansas City area and amounts to about 13 mgd (million callons per day). A rough approximation (million gallons per day). A rough approximation of water used for irrigation is about 1.25 mgd; combined municiple, industrial, and irrigation use amounts to about 28 mgd; 85 percent of this is pumped from the alluvium between Kansas City and Industrial, Irrigation walls in the area have and Independence. Irrigation wells in the area have and Independence. Irrigation wells in the area have reported pumping rates of around 1,000 gpm, and specific capacities ranging from 50 to 150 gpm per foot of drawdown. Water in alluvium in this reach of the valley is a calcium bicarbonate type, characterized by a high hardness and high iron content. (Knapp-USGS)

THE THREE-PHASE DOMAIN IN HYDROLO-

GY, Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab. C. H. M. van Bavel.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 23-32, 1968, 10 p, 19 ref.

Descriptors: *Unsaturated flow, *Saturated flow, *Porous media, *Groundwater movement, *Soil water movement, Permeability, Hydraulic conductivity, Porosity, Hydrogeology, Hydrology, Infiltration, Percolation, Discharge (Water), Recharge, Aquifers, Soils, Soil water, Groundwater. Identifiers: *Multiphase flow (Porous media).

The importance of the unsaturated zone relative to the hydrologic cycle as a whole is considered. The domain of unsaturated water movement is distinguished as a 3-phase system in order to stress the point that its essential characteristics derive from a time-variant proportion of gas and liquid in a solid matrix. This proportion changes as infiltration alternates with drainage and redistribution of water and as recharge is offset by evaporation and transpiration. The water content of the matrix determines the mobility of the liquid phase and the direction and magnitude of the resultant driving forces acting per unit mass of water. Prediction of the behavior of unsaturated systems by either mathematical, numerical, modeling or analog methods is instructive but often too idealized. Practical progress must also lean heavily upon systematic observation of water content and water potential in the zone reaching from the surface to the domain of saturation and of maximum hydraulic conductivity. Many hydrological field studies are completely lacking in this respect. Yet, a number of important hydrologic processes, such as surface exaporation, surface or overland runoff, transpiration by vegetation, interflow and accretion by groundwater reservoirs, are significantly influenced by the physical disposition of the unsaturated zone toward water movement. From a combination of theory and measurement in this area, the behavior of hydrological systems with regard to water yields, stream flow characteristics, and transport and emergence of pollutants, ought to become better understood and more successfully controlled. (See also W70-09261). (Knapp-USGS) W70-09260

VALIDITY CONDITIONS OF THE POINT DILUTION METHOD, Academia R. P. R., Bucharest. E. Gaspar, and M. Oncescu.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 256-263, 1968. 8 p, 5 fig, 1 tab, 11 ref.

Descriptors: *Groundwater movement, *Measurement, *Tracers, *Tracking techniques, Calibrations, Radioisotopes, Nuclear meters, Instrumentation, Boreholes, Water level fluctuations. Identifiers: *Point dilution tracer methods.

Methods for measuring groundwater movement using instrumented wells and tracer studies are discussed. The field techniques and difficulties of discussed. The field techniques and difficulties of using the point dilution method are explained, and correction factors are tabulated. The effects of drilling on the hydrodynamic fields of aquifers are summarized briefly. (See also W70-09285) (K-napp-USGS) W70-09284

GROUNDWATER BASIC DATA, PART 2 OF GEOLOGY AND GROUNDWATER GEOLOGY AND GROUNDWATER RESOURCES OF MERCER AND OLIVER COUNTIES, NORTH DAKOTA, Geological Survey, Bismarck, N. Dak.

North Dakota Geological Survey Bulletin 56 and North Dakota Water Commission Groundwater Studies 15, 1970. 268 p, 2 fig, 1 plate, 6 tab, 11 ref.

Descriptors: *Groundwater, *Water resources, *North Dakota, Data collections, Hydrologic data,

Hydrogeology, Water wells, Water quality, Sampling, Springs, Water levels, Observation wells, Particle size, Aquifers.
Identifiers: Mercer County (ND), Oliver County

Data were collected to be used to: (1) determine the location, extent, and nature of the major aquifers of Mercer and Oliver Counties, North Dakota; (2) evaluate the occurrence and movement of groundwater, including the sources of recharge and discharge; (3) estimate the quantities of water stored in the aquifers; (4) estimate the potential yields to wells tapping to major aquifers; and (5) determine the chemical quality of the groundwater. The information in this report was collected chiefly between 1966 and 1969, and consists of the following: (1) Data on about 1,300 wells and test holes; (2) data on 9 springs; (3) water-level measurements in 29 observation wells; (4) logs of 299 test holes and selected wells; (5) chemical analyses of 160 water samples, and (6) 25 particle-size distribution curves. (Knapp-USGS) W70-09367

TIDAL PHENOMENA IN THE KARSTIC

WATER LEVEL, Research Inst. for Water Resources Development, Budapest (Hungary). L. Maucha, and I. Sarvary.

Bulletin International Association of Scientific Hydrology, Vol 15, No 2, p 39-45, June 1970. 7 p,

Descriptors: *Springs, *Karst, *Water level fluctuations, *Siphons, *Tides, Tidal effects, Discharge (Water), Water circulation, Water levels, Aquifers, Groundwater movement. Identifiers: Earth tides.

In the north-eastern part of Hungary, in the vicinity of the Josvafo Karst Research Station, there are two karstic springs with siphonal discharge. On the basis of the periodicity of discharge, it can be assumed that water yield may be influenced by tidal phenomenon in the karstic water level. Systematic measurements and interpretations have proved the correctness of this assumption. The narrowing and widening of the conduits of the aquifers was measured simultaneously with spring strain gages. A close relationship was found to exist between the variation of gravity and the changes in the size of the openings. Information was obtained on tidal phenomena in the solid crust. The influence of the variation of the gravitation field can also be shown to have affected the yield of non-siphonal karstic springs. (Knapp-USGS)
W70-09368

HYDROLOGICAL ANALYSIS OF VOLCANIC TERRANE: LOWER BASIN OF THE RIO GRANDE DE SAN MIGUEL, EL SALVADOR, Food and Agriculture Organization of the United

Nations, Kingston (Jamaica).
For primary bibliographic entry see Field 03B.
W70-09370

ON THE SOLUTION OF INVERSE PROBLEMS IN HYDROGEOLOGY (FRENCH), SCET/Cooperation-BCA, Puteaux (France).

A. Korganoff.

Bulletin International Association of Scientific Hydrology, Vol 15, No 2, p 67-78, June 1970. 12 p,

Descriptors: *Model studies, *Transmissivity, *Storage coefficient, *Aquifers, Groundwater movement, Mathematical models, Computer models, Networks, Mathematical studies, Systems analysis, Flow nets.

Identifiers: Inverse hydrologic problem.

The inverse problem consists of the determination of the transmissivity and the storage of an aquifer at every point of a net. The equations of the problem are generally undetermined and smoothing condi-

Group 2F—Groundwater

tions are usually introduced. Two other types of constraints are considered: knowledge of the transmissivity, and the storage of points and in regions of equal values. Several different solutions are given according to the relative importance of each constraint, and according to the selected norm. In the case of the Euclidean norm, solutions can be expressed very simply by means of pseudo-inverses. (Knapp-USGS) W70-09371

ESTIMATING STORAGE CAPACITY IN DEEP BY **GRAVITY-SEISMIC** METHODS.

Agricultural Research Service, Tucson, Ariz.
Southwest Watershed Research Center.
D. E. Wallace, and D. P. Spangler.
French resume. Bulletin International Association

of Scientific Hydrology, Vol 15, No 2, p 91-104, June 1970. 14 p, 9 fig, 2 tab, 13 ref.

Descriptors: *Water storage, *Alluvium, *Aquifers, *Seismic studies, *Gravity studies, Storage coefficient, Groundwater basins, Sedimentary basins (Geological), Exploration, Surveys, Investigations, Arizona, Water resources develop-

Identifiers: Basin and Range region, Groundwater prospecting.

Large volumes of groundwater are contained in the deep intermontane valleys of Basin and Range regions. Determining the shape and storage capacity of these basins by drilling can be expensive and dif-ficult because of the depth of alluvium and large areas involved. These difficulties can often be overcome by combining gravimetric and seismic refraction interpretations. The basin boundaries are determined by gravimetric methods, with bulk density samples taken of all representative formations. Density values can then be correlated with seismic velocities to estimate subsurface porosities. Seismic velocity varies inversely with porosity for the alluvial deposits. These values can be correlated with their respective formations in the basin from geologic sections derived from the seismic refraction survey. Thus, with volume and porosity of the alluvium known, storage capacity (both present and potential) can be computed. (Knapp-USGS) W70-09373

DETERMINATION OF THE VELOCITY AND DIRECTION OF GROUNDWATER FLOW BY RADIOISOTOPES, Middle Eastern Regional Radioisotope Center for the Arab Countries, Cairo (Egypt).

French resume. Bulletin International Association of Scientific Hydrology, Vol 15, No 2, p 11-15, June 1970. 5 p, 1 fig, 1 tab, 9 ref.

Descriptors: *Groundwater movement, *Tracers, *Tracking techniques, *Iodine radioisotopes, Observation wells, Sampling, Monitoring, Permeability, Velocity, Radioisotopes, Radioactivity techniques, Aquifers, Transmissivity, Porosity. Identifiers: Groundwater tracers, Aquifer testing.

A tracer method was developed for determination of the velocity and direction of groundwater flow. Derived theoretical considerations together with Derived theoretical considerations together with model basin experiments verify this method. For this purpose, a pumped well and two piezometers were used. A proper quantity of the radioisotope I-131 was injected in the first piezometer and moved with groundwater flow. Pumping was started and the time of arrival of I-131 in the pumped water was recorded. The pumping rates, the aquifer dimensions and the effective porosity and can be calculated. (Knapp-USGS) W70-09386

GROUNDWATER GEOPHYSICS/1967. Geological Survey of Canada, Ottawa (Ontario). For primary bibliographic entry see Field 07B. W70-09392

GEOPHYSICS IN PROSPECTING AND EX-PLORATION FOR MINERAL DEPOSITS IN THE U.S.S.R.,

Ministerstvo Geologii, Moscow (USSR) For primary bibliographic entry see Field 07B. W70-09393

ELECTROMAGNETIC AERIAL SURVEY OF A FRESH WATER-SALT WATER CONTACT IN THE RHONE DELTA (FRENCH),

Bureau of Geologic and Mine Research (France); and Geoterrex Co. (France).

For primary bibliographic entry see Field 07B. W70-09394

GEOPHYSICAL **PROSPECTING** RESEARCH ON UNDERGROUND WATER (FRENCH),

For primary bibliographic entry see Field 07B. W70-09395

GEOPHYSICS IN UNITED NATIONS PRO-JECTS.

United Nations, New York For primary bibliographic entry see Field 07B. W70-09397

APPLIED GEOPHYSICS IN THE NATURAL ENVIRONMENT RESEARCH COUNCIL IN GREAT BRITAIN,

Institute of Geological Sciences, London (En-

For primary bibliographic entry see Field 07B. W70-09398

THE USE OF SEISMIC REFRACTION AND GRAVITY METHODS IN HYDROGEOLOGICAL INVESTIGATIONS,

Geological Survey, Raleigh, N.C.; and North Carolina Univ., Raleigh. For primary bibliographic entry see Field 07B. W70-09399

BOREHOLE GEOPHYSICS AS APPLIED TO GROUNDWATER, Geological Survey, Denver, Colo.

For primary bibliographic entry see Field 07B. W70-09400

GEOPHYSICAL PROSPECTING GROUNDWATER IN THE SOVIET UNION, Moscow State Univ. (USSR). For primary bibliographic entry see Field 07B. W70-09401

A REVIEW OF SOME PROBLEMS OF SEISMIC PROSPECTING FOR GROUNDWATER IN SURFICIAL DEPOSITS, Saskatchewan Univ., Saskatoon. For primary bibliographic entry see Field 07B. W70-09402

INTEGRATION OF GEOPHYSICAL METHODS FOR GROUNDWATER EXPLORATION IN THE PRAIRIE PROVINCES, CANADA, Research Council of Alberta, Edmonton.

For primary bibliographic entry see Field 07B. W70-09403

INTEGRATION OF GEOPHYSICS AND HYDROGEOLOGY IN THE SOLUTION OF REGIONAL GROUNDWATER PROBLEMS, Water Planning for Israel Ltd., Tel-Aviv. For primary bibliographic entry see Field 07B. W70-09404

THE ROLE OF GEOPHYSICS IN THE DEVELOPMENT OF THE WORLD'S GROUND-WATER RESOURCES, Geological Survey, Denver, Colo.

For primary bibliographic entry see Field 07B. W70-09405

SEISMIC METHODS IN MINING AND GROUNDWATER EXPLORATION, Geological Survey of Canada, Ottawa (Ontario). For primary bibliographic entry see Field 07B. W70-09406

APPLICATION OF RESISTIVITY METHODS IN MINERAL AND GROUNDWATER EXPLORA-

TION PROGRAMS, Colorado School of Mines, Golden. For primary bibliographic entry see Field 07B. W70-09407

THE USE OF GRAVIMETER MEASUREMENTS IN MINING AND GROUNDWATER EXPLORA-TION.

Geonautics, Inc., Washington, D.C. For primary bibliographic entry see Field 07B. W70-09408

INTERPRETATION OF GEOELECTRICAL RE-SISTIVITY MEASUREMENTS FOR SOLVING HYDROGEOLOGICAL PROBLEMS,

Federal Earth Research Inst., Hanover (West Germany) For primary bibliographic entry see Field 07B. W70-09409

GROUNDWATER RECORDS OF SOUTH CAROLINA - 1966,

CAROLINA - 1700,
Geological Survey, Columbia, S.C.
G. W. Stock, Jr. and G. E. Siple.
South Carolina Division of Geology Miscellaneous Report No 5, 1969. 39 p, 8 fig, 2 tab, 9 ref.

Descriptors: *Hydrologic data, *Groundwater, *South Carolina, Water levels, Water quality, Aquifers, Observation wells, Water wells, Water level fluctuations, Water yield, Evapotranspiration, Data collections. Identifiers: Groundwater data.

During 1966, water levels were monitored in 33 observation wells in the South Carolina Coastal Plain. Four record high and nine record low water levels were recorded during the period. In general, water levels in wells unaffected by pumping reached maximum stage during the winter or early spring months and declined during the summer as a result of high discharge because of evapotranspiration and decreased recharge. Although precipitation records showed greater than normal rainfall, some areas experienced below normal rainfall and a decline in water level in several observation wells during the latter part of the year, when normally these levels would have recovered to higher stages. Waters from the sand aquifers of Tertiary and Cretaceous age in the inner Coastal Plain are acidic, soft and have a low dissolved-solids content. As these waters move towards points of discharge in coastal areas they become alkaline and higher in bicarbonate and dissolved solids content and are characterized as a sodium bicarbonate type. Limestone waters were hard, slightly alkaline, and of a calcium bicarbonate type. Progressive salt-water encroachment was not detected in any of the principal aquifers. (Knapp-USGS) W70-09411

2G. Water in Soils

METHODS OF COMPUTING MAXIMUM SOIL FREEZING DEPTH. For primary bibliographic entry see Field 02C. W70-09104

NUMERICAL MODELING OF UNSATURATED GROUNDWATER FLOW AND COMPARISON OF THE MODEL TO A FIELD EXPERIMENT, Kansas Univ., Lawrence, and Geological Survey, Garden City, Kans.

For primary bibliographic entry see Field 02F. W70-09107

POST-IRRIGATION MOVEMENT OF SOIL WATER: 1. REDISTRIBUTION, Wisconsin Univ., Madison.

W. R. Gardner, D. Hillel, and Y. Benyamini. Water Resources Research, Vol 6, No 3, p 851-861, June 1970. 11 p, 7 fig, 19 ref. ARS Grant FG-

Descriptors: *Soil water movement, *Irrigation water, Percolation, Unsaturated flow, Hysteresis, Equations, Laboratory tests, Wetting, Nuclear moisture meters, Permeameters, Instrumentation. Identifiers: Soil water redistribution.

Water content measurements by gamma-ray attenuation in soil columns were made during redistribution following irrigation. Approximate solutions of the unsaturated flow equation are derived that describe the water content above the initial wetting front as a function of time. For times sufficiently large, these solutions reduce to a frequently used empirical expression, using constants related to the capillary conductivity and soil water dif-fusivity. (Knapp-USGS) W70-09124

FACTORS AFFECTING SEED GERMINATION UNDER SOIL MOISTURE STRESS,

National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research. For primary bibliographic entry see Field 021. W70-09135

MIGRATION OF SOLUBLE SALTS IN AN IR-RIGATED FIELD IN RELATION TO RAINFALL AND IRRIGATION,

Department of Agriculture, Lethbridge (Alberta). Water Resources Div.

For primary bibliographic entry see Field 03C.

THE TERRESTRIAL ECOLOGY OF THE SPADEFOOT TOAD SCAPHIOPUS HAMMON-

California Univ., Riverside. Dept. of Life Sciences. R. Ruibal, Lloyd Tevis, Jr., and Virgilio Roig. NSF Grant No. GB2447 and Philip L. Boyd Desert Research Center Support. Copeia, No 3, p 571-584, Aug 29, 1969. 5 fig, 7 tab, 32 ref.

Descriptors: *Toads, *Physiological ecology, *Burrows, *Soil water movement, *Water balance, Animal physiology, Distribution patterns, On-site investigations, Ecology, Semiarid climates, Osmotic pressure, Moisture tension, Soil physical properties, Soil moisture, Soil temperature, Precipitation

Precipitation.
Identifiers: *Anurans, Fossorial animals.

Spadefoot toads live in burrows in Southeastern Arizona from September to the beginning of the rainy season in July. The burrows are not located randomly. Regardless of methods used, it was virtually impossible to locate them without first seeing the toads emerge. They first emerged in several desert grassland sites in early July following an extremely light rain without runoff. Twenty-two of these animals were sacrificed, and only 2 had stomach contents. Of 16 animals captured after the first heavy rainfall, 12 had stomach contents. It appears that at least some individuals move to the surface before the rains begin and are able to detect environmental cues, however slight. Although several species were seen, only the burrows of S. hammondii were found, always in sand soil.

Average burrow depths ranged from 24-42 centimeters, increasing from September to June. Soil

moisture measurements and laboratory data indicated the toads can absorb soil moisture through their skin when soil moisture tension is as high as 10 atmospheres. As soil moisture tension increases through the winter, their osmotic pressures increases by metabolic urea production. Apparently skin water permeability is, paradoxically, the crucial adaptation to desert survival for these toads. (Casey-Arizona)

KINETIC AND EQUILIBRIUM STUDY OF THE ADSORPTION OF THE ORGANIC INSEC-TICIDES CARBARYL AND PARATHION UPON SOME SOIL ORGANIC MATTER SURFACES,

Purdue Univ., Lafayette, Ind.
For primary bibliographic entry see Field 05A.

ON THE ADHESION OF PORE WATER IN FIN-NISH ARGILLACEOUS SEDIMENTS OF DIF-FERENT AGE,

Helsinki Hydrological Office (Finland).

Jouko Soveri.

Nordic Hydrology, Vol 1, No 2, p 111-119, 1970. 9 p, 7 fig, 2 ref.

Descriptors: *Soil water, *Soil moisture, *Compaction, *Clays, Soil compaction, Capillary water, Pore pressure, Porosity, Hysteresis, Soil water movement, Retention, Consolidation, Soil mechanics, Soil engineering. Identifiers: *Finland.

The conduct of pellicular water is influenced by adhesion forces in fine grain soils of different age and at different degrees of consolidation. Determinations were made by compression apparatus, by which it was possible to indicate the extrusion of pore water and the change of void ratio as well as the degree of consolidation of the natural state. During experiments the samples were subjected to loads of 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, and 16.0 kg/sq cm. For proper performance of the process each load was left on for 24 hours. The measurement of one sample together with the decompressionrecompression experiment required 12 days and nights. The adhesion of pellicular water in older samples of similar consolidation is stronger, and older samples retain comparatively more water. (Knapp-USGS)
W70-09195

FINITE ELEMENT METHOD OF ANALYZING STEADY SEEPAGE WITH A FREE SURFACE,

California Univ., Berkeley.
Shlomo P. Neuman, and Paul A. Witherspoon.
Water Resources Research, Vol 6, No 3, p 889-897, June 1970. 9 p, 8 fig, 25 ref.

Descriptors: *Seepage, *Groundwater movement, *Free surfaces, *Dams, *Mathematical models, Digital computers, Aquifors, Water table, Leakage, Percolation, Anisotropy, Porous media. Identifiers: Finite element analysis.

A new iterative approach to steady seepage of groundwater with a free surface was developed using the finite element method. This approach eliminates a number of difficulties that were inherent in the iterative procedures previously used to solve this problem, and rapid convergence is now assured in all cases. The method is applicable to heterogeneous porous media with complex geometric boundaries and arbitrary degrees of anisotropy. It can handle problems where the free surface is discontinuous and where portions of the free surface are vertical or near vertical. In addition, infiltration or evapotranspiration at the free surface can be handled with ease. Several examples are included to demonstrate the power of this new approach and to show how it can apply to a wider variety of free surface problems than has been possible before. (Knapp-USGS)
W70-09198

A MOVING BOUNDARY MODEL OF A ONE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIENT POROUS FLOW SYSTEM,

Stanford Univ., Calif.

George M. Hornberger, and Irwin Remson. Water Resources Research, Vol 6, No 3, p 898-905, June 1970. 8 p, 9 fig, 15 ref.NSF Grant GK 4525.

Descriptors: *Groundwater movement, *Soil water movement, *Saturated flow, *Unsaturated flow, *Mathematical models, Unsteady flow, Porous media, Digital computers, Water level fluctuations, Infiltration, Recharge.
Identifiers: Finite difference analysis.

A moving boundary model is proposed for one-dimensional transient flow of water through a porous medium of which part is saturated and part is unsaturated. The model is based upon a theory that implies a discontinous propagation of pore pressure at the saturated-unsaturated interface. The moving boundary model is used to study a gravity drainage problem. Two numerical procedures are developed to solve the problem, an approximate Taylor series method and a finite dif-ference method. The validity of the methods was appraised by comparing the results with experimental data. The Taylor series method is limited in applicability because of a need for accurate determination of derivatives of hydraulic conductivity and of moisture content respecting pressure head.
The finite difference solution is very efficient because only changes in the unsaturated region are computed and the need for iteration is obviated. (Knapp-USGS)
W70-09199

HYSTERESIS IN TWO SANDS AND THE INDE-PENDENT DOMAIN MODEL, Commonwealth Scientific and Industrial Research

Organization, Canberra (Australia). T. Talsma.

Water Resources Research, Vol 6, No 3, p 964-970, June 1970. 7 p, 3 fig, 27 ref.

Descriptors: *Hysteresis, *Unsaturated flow, *Wetting, *Sands, Moisture content, Hydraulic conductivity, Potential flow, Hydraulics, Steady flow, Unsteady flow, Model studies, Hydraulic models, Capillary action. Identifiers: Capillary hysteresis. *Hysteresis, *Unsaturated flow,

Hysteresis in the relations between moisture content, potential, and conductivity was measured on two sands, one fine grained and the other coarse and angular grained. Hydraulic conductivity was and angular grained. Hydraulic conductivity was determined during steady flow at selected capillary potentials. Water uptake and release from the samples was measured volumetrically at equilibrium points using multistep increments of capillary potential. Sets of primary draining and wetting scanning curves were obtained for both sands. Anomalies existed in the total water release and uptake for high prain hands and scanning curves of take for both main branch and scanning curves of the coarse sand. Considerable hysteresis occurred in the moisture content-potential and conductivitynt the moisture content-potential and conductivity-potential relationships but little, if any, hysteresis was observed in the moisture content-conductivity relationships. The independent domain theory of hysteresis predicted the scanning curves moderate-ly well for the greater part of the hysteresis regions. Significant deviations were found in the high moisture content range in the fine grained sand. (Knapp-USGS)
W70-09209

EXPERIMENT IN THE LEACHING OF SALINE LAND IN SOUTHERN KAZAKHSTAN For primary bibliographic entry see Field 03C. W70-09258

THE THREE-PHASE DOMAIN IN HYDROLO-

Agricultural Research Service, Phoenix, Ariz.
Water Conservation Lab. For primary bibliographic entry see Field 02F. W70-09260

Group 2G—Water in Soils

AND HYDROPHYSICAL **PROPERTIES** MOISTURE REGIME IN THE UNSATURATED

ZONE, A. A. Rode

French resume. In: Water in the Unsaturated Zone. Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 33-48, 1968. 16 p, 5 fig, 1 tab, 21 ref.

Descriptors: *Soil water, *Unsaturated flow, *Soil water movement, Percolation, Infiltration, Recharge, Hydrogeology, Water storage, Moisture tension, Retention, Zone of aeration, Vadose

Identifiers: *Soil moisture regime.

The unsaturated zone consists of the strata extending from the surface down to the upper aquifer. These strata are porous. Pores are small and changeable in size and shape. Particles surrounding pores are characterized by high values of the specific surface and surface energy. The surface energy and gravity determine the behavior of moisture in the unsaturated zone. The tension (effective value of the surface energy) depends on the moisture content, reaching a maximum for dry soil and dropping to zero in saturated soil. As the change of tension proceeds, some sudden changes in properties of the soil-moisture appear. Certain values of moisture content known as hydrophysical constants correspond to these sudden changes. They quantitatively characterize the hydrophysical properties of the unsaturated zone. Most important hydrophysical constants are as follows: total waterholding capacity, minimum retentive capacity, moisture of capillary bonds rupture, wilting point, and maximum adsorptive capacity. Moisture within each interval between constants has characteristic properties and thus presents various forms of soil moisture. In the unsaturated zone layers with different forms of moisture may be distinguished. These are hydrological horizons and combinations of them form soil-hydrological profiles. Different types of moisture regime arise as controlled by climate, topography, vegetation and hydrophysical properties of the unsaturated zone. (See also W70-09262). (Knapp-USGS)

THE ROLE OF VEGETATION IN SOIL WATER PROBLEMS,

Rothamsted Experimental Station, Harpenden (England). For primary bibliographic entry see Field 021. W70-09262

COMPARATIVE STUDY OF THE WATER BALANCE IN THE AERATED ZONES WITH RADIO-ACTIVITE METHODS AND WEIGHA-BLE LYSIMETER,

Landbouwwetenschappen, Rijksfaculteit der

Ghent (Belgium).
M. De Boodt, P. Moerman, and J. De Boever.
French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 63-74, 1968. 12 p, 4 fig, 5 tab, 4 ref.

Descriptors: *Nuclear moisture meters, *Soil moisture, *Calibrations, *On-site tests, Boreholes, Lysimeters, Soil moisture meters, Instrumentation, Moisture meters, Nuclear meters. Identifiers: *Weighable lysimeters.

In a gently undulating loam deposit measurements with a neutron moisture meter yield good results in freshly drilled auger holes but poor results in old auger holes when no special precautions are taken. Possible explanation for the deviation of the results is: (1) along the access tube the tight fitting of the soil has been lost due to rain infiltration causing a widening of the hole and hence the geometry of the measurement has been lost; (2) along the access tube preferential drainage may occur so the soil in the immediate vicinity of the access tube is dryer than in the more remote parts of the soil layer. De-

pending on the climatological conditions at the beginning of a drying period, the neutron moisture will yield mostly values which are too low and at the beginning of a wetting period the results obtained will be too high when old auger holes are used. To avoid eventual water movement along the soil surface and digging up of the whole profile of a 10 ton weighable lysimeter was constructed with an aluminium access tube in the center to take moisture samples. The comparison of the results obtained with the neutron moisture meter when a whole moisture profile is assessed with those obtained with the lysimeter confirms the hypothesis of the preferential pathway along the access tube. (See also W70-09264). (Knapp-USGS) W70-09263

MEASURING SOIL MOISTURE IN THE BRENIG CATCHMENT: PROBLEMS OF USING NEUTRON SCATTER EQUIPMENT IN SOIL WITH PEATY LAYERS,

The Water Research Association, Medmenham

(England).

(England).
J. A. Cole, and M. J. Green.
French resume. In: Water in the Unsaturated Zone,
Vol I, Proceedings of the Wageningen Symposium,
The Netherlands, June 19-25, 1966, International
Association of Scientific Hydrology, Publication
No 82, p 74-88, 1968. 15 p, 7 fig, 2 tab, 13 ref.

Descriptors: *Soil moisture, *Nuclear moisture meters, *Calibrations, Moisture meters, Soil moisture meters, Clays, Soils, Permeability, Hydrogeology, Instrumentation.
Identifiers: Neutron-scatter moisture meters,

Brenig watershed (Wales).

The Brenig Catchment in North Wales has podzolic and gley soils formed from a shaley parent material in conditions of 1300 mm annual average precipitation. The top horizon of these soils is a peat layer 10 to 40 cm in depth. As part of a water balance study over the 2020 ha catchment area, soil moisture profiles are being measured with the NIS 356 neutron scatter equipment at 15 sites. The paper describes the selection of an appropriate calibration curve for each horizon of the soil, relating neutron count to soil moisture, with due allowance for soil density, and content of iron or organic hydrogen. The correction of field observations for interface effects is discussed on the basis of laboratory measurement of interfaces with various moisture contrasts. The combination of random and systematic errors of measurement is fully discussed. After consideration of the total change in moisture contents at each locality in the Brenig Catchment, between one date and another, the variance of these changes during 1965 is found to be greater than would be explained by the individual errors of measurement. (See also W70-09265). (Knapp-USGS)

AN INSTRUMENT FOR MEASURING SOIL MOISTURE BY NEUTRON SCATTERING, Swedish Meteorological and Hydrological Inst., Stockholm (Sweden). For primary bibliographic entry see Field 07B.

CHANGES IN THE MOISTURE CONTENT OF THE TOPSOIL AS MEASURED WITH A NEUTRON MOISTURE GAUGE,

Institute of Technology, Stockholm (Sweden). E. Danfors.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 96-104, 1968. 9 p, 6 fig. 3 ref.

Descriptors: *Nuclear moisture meters, *Soil moisture meters, *Calibrations, Moisture content, Nuclear meters.

Identifiers: *Neutron moisture gage (Surface).

In soils, the top layer may generally be regarded as the horizon which has the greatest hydrologic activity. As border zone between atmosphere and earth it is naturally involved in hydrological processes such as runoff, infiltration and evapotranspiration. Fluctuations in the moisture content of the topsoil reflect not only the characteristics of these activities, but also the capabilities: of the soil as medium. A neutron surface gage (model P21 d/M Gauge, Nuclear Chicago Corporation) has been calibrated to register the moisture content in soils to a depth of 10 cm. Intermittent moisture measurements have been made with a few hours to a few days time spacing. The fluctuations observed have been related to several factors such as soil texture and structure, exposure and weather conditions. Adequate means of expressing moisture characteristics of the topsoil have also been considered with the purpose of attaining hydrologic significance. The neutron surface gage has been found to be an excellent tool in these investigations because of its speed of measurement, non-destructiveness and reliability. (See also W70-09267). (Knapp-USGS) W70-09266

THE DETERMINATION OF SOIL MOISTURE WITH THE NEUTRON SCATTERING METHOD IN FINLAND

Finnish Hydrological Office, Helsinki. For primary bibliographic entry see Field 07B. W70-09267

NEUTRON MOISTURE METER FOR SALINE

All-Union Scientific and Research Institute of Hydrotechnics and Reclamation (USSR). For primary bibliographic entry see Field 07B. W70-09268

MEASUREMENT OF SOIL MOISTURE FROM THE TEMPERATURE GRADIENT,

Forest Research Inst., Budapest (Hungary For primary bibliographic entry see Field 07B. W70-09269

SOME METHODS FOR THE DETERMINATION OF SOIL MOISTURE AND BALANCE MEA-SURING,

Hydraulic Research Inst., Prague zechoslovakia) For primary bibliographic entry see Field 07B. W70-09270

POLISH POLISH ISOTOPE APPARATUS RESEARCH ON SOIL MOISTURE. FOR For primary bibliographic entry see Field 07B. W70-09271

NUCLEAR TECHNIQUES IN HYDROLOGICAL INVESTIGATIONS IN THE UNSATURATED

International Atomic Energy Agency, Vienna (Austria). Div. of Research and Laboratories. For primary bibliographic entry see Field 07B. W70-09272

CALIBRATION AND EVALUATION OF A WIDE RANGE METHOD FOR MEASURING MOISTURE STRESS IN FIELD SOIL SAMPLES, Geological Survey, Denver, Colo. Water Resources

For primary bibliographic entry see Field 07B. W70-09273

HYDRAULIC AND PRESSURE HEAD MEA-SUREMENT WITH STRAIN GAUGE PRESSURE TRANSDUCERS,

Illinois Univ., Urbana; and Agricultural Research Service, Urbana.

For primary bibliographic entry see Field 07B W70-09274

DIRECT MEASUREMENT OF MOISTURE POTENTIAL: A NEW TECHNIQUE, Commonwealth Scientific and Industrial Research

Organization, Canberra (Australia). Div. of Plant

For primary bibliographic entry see Field 07B. w70-09275

WATER TRANSPORT IN SOILS BY EVAPORA-TION AND INFILTRATION, Rothamsted Experimental Station, Harpenden

(England).

For primary bibliographic entry see Field 02D. W70-09276

CAPILLARY CONDUCTIVITY DATA ESTI-MATED BY A SIMPLE METHOD,

Institute for Land and Water Management Research, Wageningen (Netherlands). For primary bibliographic entry see Field 07B. W70-09277

DIFFUSIVITY DETERMINATION BY A NEW OUTFLOW METHOD, Commonwealth Scientific and Industrial Research

Organization, Canberra (Australia). Div. of Plant

For primary bibliographic entry see Field 07B. w70-09278

A STUDY ON PRESSURE MEMBRANE PRO-PERTIES IN RELATION TO CAPILLARY CON-DUCTIVITY MEASUREMENTS,

Deutsche Akademie der Landwirtschaftswis-senchaften zu Berlin (East Germany).

E. Vetterlein.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 203-213, 1968. 11 p, 9 fig, 4 tab, 4 ref.

Descriptors: *Capillary conductivity, *Membrane processes, *Osmosis, *Measurement, *Calibrations, Permeability, Soil water movement, Saturated flow, Unsaturated flow, Pore pressure, Soil

temperature, Viscosity.
Identifiers: Water flow-osmotic pressure relations.

Experiments on permeability properties of pressure membranes lead to the following conclusions: The decrease of permeability of pressure membranes together with pressure increase on one side of the membranes was proved to be a combined effect of the pressure distribution in the water of membrane pores and turbulent flow of water. Measurements of permeability of pressure membranes carried out with the double membrane method--the mem-branes being in contact with the unsaturated soil-are similar to values of membrane permeability measured under conditions of saturated water flow. The temperature coefficients of membrane permeability and of capillary conductivity of soil are nearly equal. Apparently they are a function of the variations of water viscosity with temperature. Altogether the results of measurements state the possibility of a simple correction of membranes impedance on capillary conductivity measurements by means of the double membrane method. (See also W70-09280) (Knapp-USGS) W70-09279

SOIL WATER DIFFUSIVITY AND WATER CONTENT DISTRIBUTION DURING OUT-FLOW EXPERIMENT,
California Univ., Davis. Dept. of Water Science and Engineering; Oklahoma State Univ., Stillwater;
Arizona Univ., Tucson; and North Dakota State

Univ., Fargo.
J. M. Davidson, J. W. Biggar, D. R. Nielsen, A. W.
Warrick, and D. R. Cassel.
French resume. In: Water in the Unsaturated Zone,

Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication

No 82, p 214-223, 1968. 10 p, 7 fig, 15 ref. Grant No DA-36-039-63-G5.

Descriptors: *Soil water movement, *Diffusivity, *Measurement, *Instrumentation, Calibrations, Moisture stress, Pore pressure, Membrane processes, Osmosis, Capillary conductivity, Tensiometers, Nuclear moisture meters, Soil moisture meters, Permeameters. Identifiers: Soil diffusivity.

Difficulties with outflow or inflow systems for measuring soil water diffusivity stem from several causes. (1) The diffusivity changes so rapidly with moisture content that even for small changes created by small pressure steps, the assumption of a constant diffusivity is untenable. The measured water content redistribution within the sample during outflow is not compatible with that calculated for a constant diffusivity value. Hence, the volumetric outflow curves can only be matched approximately--giving rise to large discrepancies. (2) The attendant errors introduced by using a porous plate are difficult to overcome. Even if its impedance were estimated with sufficient accuracy, the additional contact impedance between plate and soil would remain undefined and dependent upon both soil water content and flux. (3) Different moisture content versus soil water pressure relations for different rates of establishing a given pressure yield inconsistent results regardless of plate or contact impedance corrections. Accurate gamma absorption techniques are available for soil water pressure monitoring especially in the tensiometer range. Calculations of diffusivity would not hinge on an assumption regarding the nature of the diffusivity and the rate of volumetric outflow. (See also W70-09281) (Knapp-USGS) W70-09280

AN INFILTRATION METHOD FOR THE DETERMINATION OF THE CAPILLARY CONDUCTIVITY OF UNDISTURBED SOIL CORES, Institute for Land and Water Management Research, Wageningen (Netherlands). For primary bibliographic entry see Field 07B. w70-09281

DETERMINATION OF CAPILLARY CONDUC-TIVITY AND DIFFUSIVITY OF SOIL IN SITU, R. Koitzsch.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 235-244, 1968. 10 p, 2 fig, 4 tab, 9 ref.

Descriptors: *Capillary conductivity, *On-site tests, *Instrumentation, *Tensiometers, Moisture stress, Moisture tension, Diffusivity, Membrane processes, Osmosis, Hydraulic conductivity. Identifiers: In situ tensiometers.

An instrument for measuring capillary conductivity and diffusivity of soil in situ consists of a tensiome-ter with a cylindrical cup. The theory uses the analogy of heat conduction, in which a perfect conductor and the surrounding material are initially at different temperatures. It takes into account the influence of the hydraulic conductivity of the cup wall and the influence of an additional contact resistance which may sometimes exist. Suggestions are made for the design of the instrument and for reducing the nunber of observations. Simplification of interpretation is possible when the influence of the cup wall can be neglected and when an additional contact resistance does not occur. Experiments yielded capillary conductivity as well as diffusivity. (See also W70-09283) (Knapp-USGS) W70-09282

DETERMINATION OF THE COEFFICIENTS OF WATER MIGRATION THROUGH SOILS,

Institute of Hydrotechnical Research, Bucharest (Rumania). R. J. Bally.

French resume. In: Water in the Unsaturated Zone, Vol 1, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 245-256, 1968. 12 p, 12 fig, 2 ref.

Descriptors: *Soil water movement, *Mathematical studies, Moisture tension, Moisture content, Capillary conductivity, Flow, Hydraulic gradient, Darcys law, Laboratory tests, Model studies, Pore

Identifiers: Soil water movements equations.

Differential equations for one-dimensional vertical and horizontal flow in the soil and the use of these equations for the determination of capillary conductivity and suction in relation to the soil moisture content are presented. Two conditions were used: (1) the continuity of water flux; (2) the equality between suction gradient in an elementary soil layer and the flow resistance in order to assure the increase in soil moisture content. The differential equations are functions of: variation in soil moisture content as a function of distance and time; capillary conductivity as a function of soil moisture content; suction as a function of soil moisture content. A verification of the proposed method is given with data from laboratory experiments. (See also W70-09284) (Knapp-USGS) W70-09283

VALIDITY CONDITIONS OF THE POINT DILUTION METHOD,

Academia R. P. R., Bucharest. For primary bibliographic entry see Field 02F.

DIVERGENCES BETWEEN EXPERIMENTAL AND THEORETICAL VALUES OF CAPILLARY DIFFUSIVITY (FRENCH), State Coll. of Agronomical Sciences, Gembloux

(Belgium).

(Belgium). L. Sine, and A. Bentz. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International As-sociation of Scientific Hydrology, Publication No 82, p 263-277, 1968. 15 p, 13 fig, 1 tab, 17 ref.

Descriptors: *Soil water movement, *Diffusivity, *Measurement, Calibrations, Moisture stress, Drying, Infiltrometers, Moisture tension, Model studies, Laboratory tests, Discharge (Water), Nuclear moisture meters, Permeameters, Membrane processes, Osmosis Identifiers: Soil diffusivity.

The systematic measurement of diffusivity at low tensions, using the method proposed by Gardner, results in the following deviations between theory and experiment: the flow through the porous plate might be higher than the value calculated from theory; the obtained value of the diffusivity is a function of the height of the sample; the discharge at the lower boundary of the sample does not at all correspond with the moistre profile predicted by theory. The development of the moisture profile in samples 15 cm height was observed, using gamma rays for the measurement of the moisture content. A deviation between theory and experiment also appeared to exist during a study of the moisture profile above a water table. The development of the moisture profile depends on the initial and boundary conditions. (See also W70 09286) (K-napp-USGS)
W70-09285

VERIFICATION OF THE GENERALIZED DAR-CY'S LAW AND DETERMINATION OF CAPIL-LARY CONDUCTIVITY AT THE BEGINNING OF HORIZONAL INFILTRATION (FRENCH), Laboratories of Fluid Mechanics, Grenoble

(France).
Georges Vachaud.
In: Water in the Unsaturated Zone, Vol I,
Proceedings of the Wageningen Symposium, The

Group 2G-Water in Soils

Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 277-294, 1968. 18 p, 7 fig, 3 tab, 9 ref.

Descriptors: *Soil water movement, *Darcys law, *Capillary conductivity, Moisture content, Hydraulic gradient, Mathematical studies, Flow, Porous media, Unsaturated flow, Nuclear moisture meters, Laboratory tests. Identifiers: Soil moisture profiles.

By analysis of both the moisture profiles, obtained by gamma ray absorption during infiltration in a soil column, and the wetting branch of the capillary pressure curve, a method is suggested for checking the validity of the generalized Darcy's law and obtaining capillary conductivity. At any time, for each value of the moisture content, the flow velocity is computed from the moisture profiles by integration of the continuity equation. The capillary gradients are obtained by substituting capillary profiles to moisture profiles. Plotting, for a given moisture content, the corresponding values of velocity versus gradient, we establish that a linear relationship exists, satisfying Darcy's law. The slope is the value of the capillary conductivity. (See also W70-09287) (Knapp-USGS)

HYDROLOGICAL CONSTANTS OF PAMPEAN SOILS: BROWN PRAIRIE AND BLACK PRAIRIE,

Buenos Aires Univ., (Argentina). Dept. of Agricultural Climatology and Fenology, and Agroclimatology Programme of the Centro de Investigaciones Agricolas Alberto Boerger, La Estanzuela

Juan J. Burgos, and Walter C. Corsi. French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 295-305, 1968. 11 p, 1 fig, 9 tab, 9 ref.

Descriptors: *Soil moisture, *Soil properties, *Prairie soils, Statistical methods, Bulk density, Field capacity, Wilting point, Sampling, Laboratory tests, Soil-water-plant relationships.
Identifiers: *Pampean soils.

Methods used to determine the hydrological constants of pampean soils are reviewed. Data measured in black and brown prairie soils are compared. The procedures for the determination of bulk density and field capacity in pampean soil gave more reliable results with the less disturbed soil samples. For this reason field tests are recommended in preference to the laboratory test made. Field capacity values for brown and black prairie or pampean soils over pampean loess are relatively high as compared to normal contents of prairie soils. Contents for these soils can be estimated at approximately 400 mm in a depth of one m. The wilting coefficient for brown prairie and black prairie soils over pampean loess is slightly higher for black prairie soils and may be estimated at between 240 and 250 mm for a depth of one m. The number of samples used in previous tests and a statistical analysis of the results disclose that in six soil samples the precision of the average bulk density was 0.02 to 0.03 g/cc; in thirteen tests to determine field capacity, precision was 10 to 13 mm per m of depth and in three samples to test wilting point, precision was 6 to 7 for a depth of one m in 95% of the cases. We consider that procedures requiring less handling of the samples and an increase in the drainage period could alter the results reported. (See also W70-09288) (Knapp-USGS) W70-09287

THE RELATION BETWEEN LITHOLOGICAL

PROPERTIES AND THE SHAPE OF THE DESCRIPTION CURVE, Institute for Land and Water Management Research, Wageningen (Netherlands). W. C. Visser.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 305-311, 1968. 7 p, 2 fig, 1 tab.

Descriptors: *Soil physical properties, *Soil moisture, Field capacity, Wilting point, Drying, Retention, Capillary water, Specific retention, Laboratory tests, On-site tests. Identifiers: Desorption curves (Soil)

The desorption curve was studied as an important hydro-lithological soil property. Visual or field methods may be used to obtain clay content, humus content, and pore space data. The relation between the lithological properties and the shape of the desorption curve appears to be complex. The accuracy of graphical methods is not high, particularly in the range between field capacity and wilting point, where the practical importance is greatest. (See also W70-09289) (Knapp-USGS) W70-09288

MICROHYDROLOGICAL CHARAC-TERIZATION OF SOILS, Guelph Univ. (Ontario). Dept. of Soil Science.

D. E. Elrick.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 311-317, 1968. 7 p, 4 fig, 1 tab, 24 ref, ap-

Descriptors: *Capillary conductivity, *Soil moisture, *Soil properties, *Classification, Moisture content, Moisture content, Moisture stress, Pore pressure, Laboratory tests, Hydraulic gradient, Soil water movement.
Identifiers: Microhydrological soil classification.

Within the limits of soil water diffusion theory, soils can be characterized with regard to their ability to transmit water by determining experimentally the relationships between soil water content and soil water pressure and between capillary conductivity and soil water content. A brief review of some methods and procedures that can be used to determine capillary conductivity and capillary diffusivity is presented. Data on the microhydrologic properties of a soil are presented and the effects of airdrying and sieving on these properties ard discussed. (See also W70-09290) (Knapp-USGS) W70-09289

EFFECTS OF SALTS AND ORGANIC MATERI-ALS ON THE HYDRAULIC CONDUCTIVITY OF THE SOILS,

National Taiwan Univ., Taipei. Dept. of Agricultural Chemistry.

Isen-tuo Chen.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 317-323, 1968. 7 p, 2 fig, 3 tab, 3 ref.

Descriptors: *Hydraulic conductivity, *Soil chemistry, *Clays, *Organic matter, *Ions, Ion exchange, Colloids, Porosity, Percolation, Laterites, Peptides, Soil water movement. Identifiers: *Latosols.

Effects of OH and CI on the hydraulic conductivity of latosol clays treated with various amounts of Ca and Na were found greater than of the cations. It was concluded that OH peptized the sesquioxide bonds on collidal surfaces and subsequently caused the decrease in stability index and volume of pores with a diameter greater than 28.4 millimicrons and increased bulk density. All of these, consequently, reduced the hydraulic conductivity. The application of carbon and nitrogen sources, combined or separated, induced clogging or aggregation of the soil, depending on the relative rate of addition. These caused a tremendous change in hydraulic

conductivities. For soils with low hydraulic conductivities, that the addition of organic materials with nitrogen increased hydraulic conductivity significantly at the end of five weeks percolation. For a soil with low hydraulic conductivity, the same treatment reduced hydraulic conductivity at the end of same period of percolation. Changes in pH, nitrogen and organic matter content and C/N before and after percolation were found insignificant. Importance of studying the changes in hydraulic conductivities caused by cultural practices or fertilization for plant growth is stressed. (See also W70-09291) (Knapp-USGS) W70-09290

SOIL MOISTURE PRESSURE IN SOME CLI-MATIC ZONES.

Institut Prikladnoi Geofiziki, Leningrad (USSR). I. I. Sudnitsin.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 323-329, 1968. 7 p, 5 fig, 1 tab, 8 ref.

Descriptors: *Soil moisture, *Climatology, *Pore pressure, Thermodynamics, Soil chemistry, Water chemistry, Soil water movement, Tensiometers, Freezing, Soil types, Moisture tension, Laboratory tests, Soil-water-plant relationships. Identifiers: Soil moisture hygroscopy.

Soil moisture pressure (or potential) is characteristic of its thermodynamic state, mobility and availability for plants. Tensiometric, cryoscopic and hygroscopic methods were used to measure the soil moisture percentage versus pressure relationships for some soils in moist, semiarid and arid zones of the European part of the USSR. At high soil moisture percentage the pressure depends on the soluble salt content, and at low soil moisture percentage it depends on the exchangeable ion distribution and the specific surface of the soil particles. During the warm season the soil moisture pressure in the aeration zone decreases regularly in the direction of north to south as the climate becomes more arid. Pressure dynamics is a good criterion for estimating soil moisture conditions in the aeration zone and in plant water supply. Pressure dynamics depends not only on the climate, but also on soil properties and vegetation, especially the depth of the root zone. (See also W70-09292). (Knapp-USGS) W70-09291

AN EMPIRICAL EXPRESSION FOR THE DESORPTION CURVE,

Institute for Land and Water Management Research, Wageningen (Netherlands).

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 329-335, 1968. 7 p, 4 fig, 1 ref.

Descriptors: *Soil moisture, *Drying, *Laboratory tests, Mathematical models, Moisture stress, Moisture content, Soil water movement, Statistical methods, Regression analysis. Identifiers: *Desorption curves.

An empirical formula for the desorption curve was devised and tested on a large number of undisturbed soil samples. The two graphical methods to assess the four parameters are discussed and an example of the solution of these unknown parameters is given. A mathematical expression was evolved to make available a check on the accuracy of separate moisture stress-moisture content observations. The further purpose was to be able to transpose such relations as those between moisture stress and moisture flow into relations between moisture content and moisture flow. (See also W70-09293). (Knapp-USGS)

Water in Soils—Group 2G

INFRARED SPECTROPHOTOMETRIC STUDY OF WET CLAY SOILS (FRENCH),

Institute of Hydrotechnical Research, Bucharest (Romania).

L. Arcan.

In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 336-334, 1968. 9 p, 11 fig, 1 tab, 7 ref.

Descriptors: *Soil structure, *Soil chemical properties, *Retention, *Moisture content, *Laboratory tests, Spectrophotometry, Plasticity, Leaching, Ion exchange, Adsorption, Clays.
Identifiers: Infrared spectrophotometry.

With the aid of infrared spectra the soil structure and the reciprocal action of soil particles and water for various clay soils in Romania was studied. The studies were performed with soils having a natural moisture content or dried at various temperatures. In order to get a correlation between the results obtained from the analysis and the physical conduct of the wet soil, the limits of plasticity, the velocity of disintegration of the soil in water and cation adsorption were determined. The study shows that it is possible to determine directly with spectrophotometry the way in which the water is held the thickness of the water film on the soil particles. (See also W70-09294). (Knapp-USGS) W70-09293 by the soil particles, the degree of orientation and

INFLUENCE OF SOIL STRUCTURE ON INFIL-TRATION AND PF VALUES OF CHERNOZEM AND CHERNOZEMLIKE DARK MEADOW SOILS.

Novi Sad Univ. (Yugoslavia). Faculty of Agricul-

French resume. In: Water in the Unsaturated Zone, Vol 1, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 344-350, 1968. 7 p, 11 tab, 14 ref.

Descriptors: *Soil moisture, *Moisture content, *Soil structure, *Chernozems, Laboratory tests, Irrigation, Leaching, Soil chemistry, Soil chemical properties, Porosity, Soil enemistry, Soil chemical properties, Porosity, Soil water movement, Infiltration, Retention, Drying, Sampling.

Identifiers: *Yugoslavia.

There is a definite correlation between the mechanical composition of a soil and the infiltration rate for non-structured or insufficiently structured soils. It is also known that soil structure changes the relation to a great extent and increases the infiltration rate. In soils with the same mechanical and structural composition, the infiltration rate is influenced by the stability of the aggregates, a quality of the soil which has not been often considered from this viewpoint. In the irrigation district of Vojvodina (Yugoslavia) 2 soil types dominate; chernozems and chernozem-like soils. They are very similar, have nearly the same mechanical and structural composition, and only very small differences in porosity, but have unequal stability of the aggregates, which causes large dif-ferences in infiltration rate. The differences are not only in the initial intake rate, but also in the time only in the initial intake rate, but also in the time coefficient, in Kostjakov's formula. Noting the changes in aggregate composition of soils under infiltration, the value of pF data determined for disturbed soil, or for aggregates which do not represent the aggregates in situ, is questionable. The greatest moisture content determined at 1/3 atm. tension, and the lowest at 15 atm., were found in charactern samples composed of aggregates of in chernozem samples composed of aggregates of less than 0.25 mm. In samples with fractions from 10 to 0.25 mm, however, no differences in moisture contents were found. These facts are of great importance in connection with those soils with large aggregates that fall apart during cultivation or irrigation practice. (See also W70-09295). (Knapp-USGS) W70-09294

ANALYSIS OF SOME FACTORS AFFECTING THE WATER VAPOUR DIFFUSION IN SOILS, Khartoum Univ. (Sudan).

M. Kutilek.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 350-360, 1968. 11 p, 11 fig, 19 ref.

Descriptors: *Soil water movement, *Diffusivity, Soil structure, Soil texture, Soil chemistry, Mathematical studies, Unsaturated flow, Mathematical models, Moisture content, Moisture tension, Drying, Evaporation.

Identifiers: *Soil diffusivity, Polyphase flow.

The diffusivity of water vapor is considered to be a general characteristic of soil moisture transport. Values of Dw were computed for various models of soils. It is concluded that two cases, different in principle, have to be distinguished when analyzing the diffusion of water vapor in soils. In heavy soils where surface active clay particles are predominant, water vapor diffusion is inucnenced by the change of geometrical parameters (e.g. porosity) to a relatively low extent, and the mineralogical composition becomes the principal factor affecting diffusion. A high content of strongly hygroscopic materials (e.g. montmorillonite) brings about the decrease of the diffusivity by about 100. The influence of exchangeable cations is reverse when compared with the influence on the flow of liquid water. The bivalent exchangeable cations lower the diffusivity and the monovalent exchangeable cations raise the diffusivity, omitting the possible change of aggregation. In light soils where silt and sand particles are prdominant, since surface properties of these particles are uniform, the water vapor diffusion is affected primarily by the change of the geometrical parameters (porosity). The range of the changes is relatively small when compared with the changes caused by mineralogical composition of the heavy soils. (See also W70-09296). (Knapp-USGS) W70-09295

MOISTURE CONTENT AND HYDROPHILITY AS RELATED TO THE WATER CAPILLARY

RISE IN SOILS, S. A. Wladitchensky. French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 360-365, 1968. 6 p, 2 fig, 5 tab, 7 ref.

Descriptors: *Soil water movement, *Capillary conductivity, *Adsorption, *Capillary action, Unsaturated flow, Capillary fringe, Capillary water, Wetting, Pore pressure, Moisture content, Mathematical studies, Laboratory tests, Soil chemical

Identifiers: Capillary rise (Soil water).

Because the limits of variation of soil properties are rather wide, an exhaustive description of capillary rise should be studied by expanding from studies of a single pore, to a system of pores, and at last to the soil as a whole. The uneven shape of the capillary rise curve is explained by differences in the dimension and shape of pores through which the water moves, and by differences in the character of pore walls. In particular the components of the soil have different hydrophility, and hydrophility of pore walls material is also influenced by adsorbed water and gas. The cosine of the wetting angle and the velocity of the capillary rise are a minimum at the hygroscopical moisture content. A series of experiments was carried out with water uptake by sand coated with humic acid. Humic acid reduces the hydrophility of sand particles and the velocities of water uptake. (See also W70-09297). (Knapp-W70-09296

DETERMINATION OF PORE SIZE BY THE AIR BUBBLING PRESSURE METHOD,

and Water Management

Institute for Land and Water Research, Wageningen (Netherlands). For primary bibliographic entry see Field 07B W70-09297

THE RELATION BETWEEN PARTICLE SIZE, PORE SIZE AND HYDRAULIC CONDUCTIVI-TY OF SAND SEPARATES, Institute for Land and Water Management

Research, Wageningen (Netherlands).

W. P. Stakman. French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 373-384, 1968. 12 p, 6 fig, 2 tab, 14 ref.

Descriptors: *Porosity, *Porous media, *Sands, *Laboratory tests, *Instrumentation, Bubbles, Permeability, Permeameters, Tensiometers, Permeability, Permeameters, Tensiometers, Groundwater movement, Soil water movement, Unsaturated flow, Surface tension, Wetting, Capillary action, Pore pressure, Hydraulic gradient, Pressure.

Identifiers: *Pore size, Pore size determination, Air-bubble permeameters.

From the air bubbling pressure of sand separates the equivalent diameter of the largest bottle-neck in the capillary system can be calculated. The measured hydraulic conductivity of the sand separates is nearly directly proportional to the square of that diameter as well as to the square of the mean particle diameter. The measured results are compared with the hydraulic conductivity calculated with the Kozeny-Carman equation, based on laminar flow through a circular straight tube and with the Brinkman formula, based on the drag theory of permeability. (See also W70-09299). (Knapp-USGS) W70-09298

REDISTRIBUTION OF MOISTURE AFTER IN-FILTRATION IN DRY SOILS. INFLUENCE OF GRAVITY.

Institut National de la Recherche Agronomique, Versailles (France). Soils Lab.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 385-389, 1968. 5 p, 2 figs, 1 tab, 6 ref.

Descriptors: *Wetting, *Soil water movement, *Percolation, Unsaturated flow, Infiltration, Drainage, Capillary action, Laboratory tests, Infil-

Identifiers: *Water redistribution.

The redistribution of water in soil after infiltration was studied by irrigating small (30 cm high and 3 cm diameter) soil columns by applying water at the tops. After infiltration, columns were sliced lengthwise immediately and after 24 hours. Others were inverted after 24 hours and examined after 24 more hours of standing inverted. The soils studied were a clay-loam, a silty clay loam, and a coarse sand. Gravity appears to have no great influence on water redistribution. It is concluded that the prinwater redistribution. It is concluded that the principal redistributive force is the attraction of dry soil in the wetting zone. (See also W70-09300). (K-napp-USGS)
W70-09299

INFILTRATION RATE AS RELATED TO HYDRAULIC CONDUCTIVITY, MOISTURE DEFICIT AND OTHER SOIL PROPERTIES,

Central Inst. for Agricultural Research, Bucharest (Romania). Soil Physics Lab.
A. Canarache, E. Motoc, and R. Dumitriu.
French resume. In: Water in the Unsaturated Zone, French resume. In: water in the obsaturated Zole, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 392-401, 1968. 10 p, 5 fig, 3 tab, 29 ref.

Group 2G-Water in Soils

Descriptors: *Infiltration, *Hydraulic conductivity, *Moisture deficit, *Soil properties, Unsaturated flow, Soil texture, Soil types, Soil profiles, Infiltrometers, Lysimeters, On-site tests, Laboratory tests, Sampling, Bulk density, Pore pressure. Identifiers: Antecedent moisture content.

Correlation and regression analyses using data for some 150 soil profiles of different genetical and textural types were performed. Soil properties involved in the calculations were infiltration rate, clay content, porosity, hydraulic conductivity and moisture status. Water infiltration into the soil takes place through the non capillary pore space being directly proportional to its volume; positive correlations exist between infiltration rate and percent of water-free pores at field capacity (r = +0.364 and +0.541), as well as between infiltration rate and log hydraulic conductivity (r = +0.520 and +0.509). At the same time, water penetrating into the soil encounters a resistance provided by the air compressed within pores ranging in size from those filled at field capacity to those filled at moisture content at the beginning of the determination. As such, infiltration rate is inversely proportional to the volume of these pores and negative correlations exist between infiltration rate and the moisture deficit (r = -0.240 and -0.216). No correlations were observed between infiltration rate and moisture content at the beginning of the determination or between infiltration rate and the total percent of water-free pores at that time. The multiple correlation coefficients involving infiltration rate, non capillary porosity and moisture deficit (R=0.446 and 0.638) or infiland monsure deficit (R = 0.446 and 0.638) or infiltration rate, log hydraulic conductivity and moisture deficit (R = 0.610 and 0.548) were higher. (See also W70-09301). (Knapp-USGS) W70-09300

INFILTRATION IN TERMS OF MOISTURE, RAIN INTENSITY AND DEPTH OF RAINFALL,

Hungarian Úniv. of Agricultural Sciences, Godollo (Hungary).

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 390-392, 1968. 3 p, 2 tab.

Descriptors: *Infiltration, *Soil water movement, *Rainfall, Penetration, Rainfall intensity, Rainfallrunoff relationships, Percolation, Retention, Soil moisture, Soil properties, Unsaturated flow. Identifiers: Rainfall depth-infiltration relationships.

Infiltration into the soil from summer rains was determined on levelled plots of meadow clay soil, 154 by 21.5 m in area, under agricultural cultivation. A close relationship was demonstrated between rain intensity, amount of rainfall, and initial soil moisture on the one hand and infiltration on the other. On the basis of the relationship determined, probable values of infiltration are compiled in tables. (See also W70-09302). (Knapp-USGS) W70-09301

THE NATURE OF THE MINIMAL WATER RE-

TENTIVE CAPACITY, Vsesoyuznaya Akademiya Selskokhozyaistvennykh Nauk, Moscow (USSR).

A. A. Rode.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 407-415, 1968. 9 p, 1 fig, 3 tab, 32 ref.

Descriptors: *Retention, *Field capacity, *Capillary water, Soil water, Water storage, Capillary ac-tion, Diffusion, Soil water movement, Soil tempera-ture, Hydraulic gradient, Moisture tension. Identifiers: *Soil water retention.

A soil uniform in texture is able to retain some water in equilibrium against gravity, providing that neither temperature nor tension gradients are effective. Such soil water is referred to as suspended moisture. The intrinsic minimal retentive capacity corresponds to maximal content of suspended moisture. The tension gradient does not operate after the solum has wetted through, and all gravitational water has moved out. If at some depth there is a dry layer with a moisture content less than minimal retentive capacity, the tension gradient arises, directed upwards from that layer. As influenced by this gradient, the suspended moisture starts moving very slowly towards the layer mentioned. This moisture is in a quasi-equilibrium state. The temperature gradient being effective and the moisture content being equal to the minimal retentive capacity, water movement as vapor opposing this gradient takes place. Losses of moisture as vapor are balanced by liquid water movement in the opposite direction. The moisture content tends to remain equal to minimal retentive capacity. The tension which corresponds to minimal retentive capacity varies considerably in soils of different texture, structures and consistence and can never become the same in soils of different characteristics. When expressed in cm of water, it equals numerically the maximal height of capillary rise. (See also W70-09303). (Knapp-USGS) W70-09302

THE MOVEMENT OF WATER IN SANDY SOILS AFTER PLOUGHING AT A DEPTH OF 50 CENTIMETERS,

Bayerische Landesanstalt fur Bodenkultur, Pflanzenbau und Pflanzenschutz, Munich (West Ger-

many). Rid Heinrich.

French resume. In: Water in the Unsaturated Zone, French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 401-406, 1968. 6 p, 9 fig, 3 tab, 5 ref.

Descriptors: *Infiltration, *Soil structure, *Soil management, Permeability, Organic matter, Soil treatment, Deep tillage, Penetration, Percolation, Pervious soils, Sands, Clays, Seepage.

Identifiers: Soil infiltration capacity improvement.

An attempt was made to improve the water capacity of two sandy soils with different clay proportions by plowing in organic matter to a depth of 50 cm. This succeeded on the sandy soil while on the slightly clayey sand, during the course of the experiments, the same water contents were always measured on deep plowed as on normally plowed plots. The texture of the soil therefore may indicate the success of deep plowing. The importance of humus and the manner of working in the humus on sandy soils is emphasized. A tendency of enrichment of the nutrients in plowed under humus layers is indicated. (See also W70-09304). (Knapp-USGS) W70-09303

A STUDY OF REDISTRIBUTION AFTER THE FINISH OF HORIZONTAL INFILTRATION (FRENCH),

Georges Vachuad.
In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 415-428, 1968. 14 p, 8 fig, 1 tab, 9 ref.

Descriptors: *Soil water movement, *Percolation, *Drainage, Unsaturated flow, Infiltration, Permeability, Hysteresis, Nuclear moisture meters, Capil-lary action, Capillary water. Identifiers: *Soil moisture redistribution.

The evolution of the moisture profiles, after the end of an infiltration in an horizontal soil column, was followed by gamma-ray absorption. During the redistribution, it appears that there exist three different zones in the column, depending on the distance to the origin. In the first zone, near the surface, the flow is a uniform drainage; in the second

one, a wetting process followed by a drainage; in the third one, the flow is a uniform wetting, at leasts for the limits of time and length choosen. Using both drainage and wetting branches of the capillary pressure curves, and analyzing the limit between the wetting and drainage flows in the column, a method is suggested for computing the capillary pressure inside the hysteresis loop for each point of the column and at any time during the redistribution. (See also W70-09305). (Knapp-USGS)

A THEORETICAL ANALYSIS AND NUMERI-CAL SOLUTIONS OF UNSATURATED FLOW

Gifu Univ. (Japan). Faculty of Agriculture.

H. Kobayashi.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 429-439, 1968. 11 p, 4 fig, 8 ref.

Descriptors: *Soil water movement, *Mathematical studies, Computers, Mathematical models, Equations, Numerical analysis. Identifiers: Differential equations.

Mathematical solutions are given for unsaturated flow in soil. The equations derived from analysis of groundwater movement are solved by numerical methods using digital computers. The problem of one-dimensional horizontal flow is solved by using the general Boltzmann's transformation and an iterative method. (See also W70-09306). (Knapp-W70-09305

ANALYSIS OF INFILTRATION STRATIFIED SOIL COLUMNS, Agricultural Research Service, Urbana, Ill.; and Il-

linois Univ., Urbana. Agricultural Experiment Sta-

F. D. Whisler, and A. Klute.
French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 451-470, 1968. 20 p, 24 fig, 12 ref. USDA Contract No 12-14-100-5742 (41).

Descriptors: *Infiltration, *Soil water movement, *Stratification, *Laboratory tests, *Mathematical models, Percolation, Equations, Unsaturated flow, Saturated flow, Hysteresis, Hydraulic gradient, Permeability, Hydraulic conductivity, Moisture

Identifiers: *Stratified soils.

A numerical solution of the flow equation for water in soil was obtained for a flow system consisting of a vertical column of stratified soil materials which had been drained from saturation to equilibrium with a water table. Water was assumed to be applied at the top of the column as either rainfall or ponded water. Infiltration into such a system involves hysteresis; the soil at each point wets along a different wetting scanning curve. The solution of the equation depicts the time and depth distributions of water content and pressure head during the resulting infiltration as well as infiltration rate and accumulated water content. The properties of the soil that influence the flow are the water capacity and hydraulic conductivity. Several hypothetical cases included coarse-textured soils overlying finetextured soils, fine-textured lenses in coarse-textured soils, and coarse-textured lenses in fine-textured soils. Comparisons were made between these cases and also nonstratified cases on the basis of pressure head-time profiles, moisture content-time profiles, infiltration rate changes, and accumulated water content changes. The numerical solution predicts a hold-up effect on the wetting front as it goes diets a noit-up effect on the wetting front as it goes from a fine-textured layer into a coarse-textured one. The rate of advance of the fronts is faster for ponded infiltration than for rainfall infiltration. (See also W70-03907). (Knapp-USGS) W70-09306

A LINEARIZATION TECHNIQUE FOR THE STUDY OF INFILTRATION,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant

J. R. Philip.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 471-478, 1968. 8 p, 2 fig, 20 ref.

Descriptors: *Infiltration, *Soil water movement, *Mathematical studies, *Digital computers, Linear programming, Equations, Hydraulic conductivity, Hydraulic gradient, Soil moisture, Moisture content.

function, Delta Identifiers: techniques.

A linearization technique is given for the solution of non-linear problems in infiltration and other problems of water movement in unsaturated soils. The method consists, essentially, in matching exactly linear and non-linear solutions at small times, and in matching the solutions in some integral sense at large times. The method is worked out for one-dimensional infiltration. It is shown to yield results agreeing closely with the 'exact' non-linear solution and to provide algebraic infiltration equations equally valid for small and large times. The parallel use of similarity (or better, delta function) solutions provides a good method of approximate analysis, since the linear and the delta function solutions represent extremes of soil characteristics and, by implication, of hydrological behavior. We may, therefore, obtain insight into the general character of the phenomenon and the extent to which it may vary, and we may obtain, at the same time, an indication of the accuracy of the results. For one-dimensional infiltration, the similarity (or delta function) solution agrees well with the linear solution. (See also W70-09308). (Knapp-USGS) W70-09307

SOLUTIONS OF THE NON-LINEAR DIFFU-SION EQUATION WITH A GRAVITY TERM IN

HYDROLOGY, Technion - Israel Inst. of Tech., Haifa; and California Univ., Berkeley.

S. Irmay.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 478-499, 1968. 22 p, 4 fig, 1 tab, 32 ref, 2 append.

Descriptors: *Soil water movement, *Diffusion, *Mathematical studies, *Equations, Digital computers, Saturated flow, Unsaturated flow, Steady flow, Unsteady flow, Evaporation, Infiltration, Water level fluctuations, Groundwater movement, Aquifers, Capillary action, Capillary water. Identifiers: Soil water movement equations.

The partial differential equation of unsaturated flow of liquids in porous media, especially of water in stable soils, is discussed: steady and unsteady flows, with or without gravity, in one-, two-, and three dimensional cases, in cartesian and cylindri-cal coordinates. The initial and boundary conditions are described, and the hodograph sphere (circle) method of saturated flow is extended to unsaturated media. A number of steady flow solutions are studied analytically and graphically. In unsteady flows the equations are transformed into an ordinary differential equation by the Boltzmann transformation, by a linear wave-like transformation, by similarity transformations, by separation of variables, and by other methods. The method outlined can be used in solving similar diffusion equations in other fields. (See also W70-09309). (K-napp-USGS)
W70-09308

SOME NUMERICAL METHODS FOR SOLVING PROBLEMS OF NON-STEADY SEEPAGE IN NON-HOMOGENEOUS ANISOTROPIC SOILS, All-Union Scientific and Research Inst. of Hydrotechnics and Reclamation (USSR).

L. N. Burejev, and Z. M. Burejeva.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 500-503, 1968. 4 p.

Descriptors: *Soil water movement, *Unsteady flow, *Seepage, *Anisotropy, *Computer programs, Mathematical studies, Digital computers, Numerical analysis, Mathematical models, Flow, Porous media, Unsaturated flow, Laplaces equa-

Identifiers: *Unsteady seepage.

A proposed method of computation of non-steady seepage consists of successive series of cycles each of which includes two stages of computation: the determination of components of speeds on a boundary and the determination of the new position of a boundary. The method makes it possible to construct an algorithm which is independent of the struct an algorithm which is independent of the specific problem. This algorithm is used as a basis of the program for the BESM computer. (See also W70-09310). (Knapp-USGS) W70-09309

ABSORPTION AND INFILTRATION IN TWO-AND THREE-DIMENSIONAL SYSTEMS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
J. R. Philip.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 503-525, 1968. 23 p, 7 fig, 18 refs.

Descriptors: *Infiltration, *Absorption, *Soil water movement, *Mathematical studies, Wetting, Capillary action, Percolation, Moisture content, Unsaturated flow, Steady flow, Unsteady flow. Identifiers: Soil moisture profiles.

The theory of the dynamics of one-dimensional infiltration is well developed, but many practical problems involve two- and three-dimensional systems. The two-dimensional problem of infiltration from a semi-circular furrow and the threedimensional problem of infiltration from a hemispherical cavity are examined. Exact series solutions of non-linear absorption problems are found which are appropriate for small times. For the three-dimensional case a steady large-time solution exists, and is evaluated. The corresponding linear and delta function solutions are also found; they agree well with the exact solutions. These various results support the argument that previous attempts to apply the Boltzmann transformation to this group of problems have been erroneous. The corresponding infiltration problems are formulated and the linear solutions developed. It is shown that: (1) the wetting region for both two- and three-dimensions is finite no matter how great the time (unlike for one dimension); and (2) the final steady state infiltration rate depends not only on the hydraulic conductivity, but also on the capillary properties of the soil. The influence of gravity in distorting the pattern of wetting decreases as the radius of the cavity or furrow decreases; and it is very much less in three dimensions than in two. (See also W70-09260). (Knapp-USGS) W70-09310

INFILTRATION PROPERTIES OF THE SOILS CHERNOZEM CENTRAL PROVINCES,

A. M. Grin, and G. V. Nazarov.

Translated from Russian. In: Water Balance and Silting of Small Reservoirs in the Central Chernozem of the Russian Soviet Federal Socialist

Republic, US Agricultural Research Service, p 76-106, 1967. 31 p, 4 fig, 13 tab, 14 ref.

Descriptors: *Soil physical properties, *Soil properties, *Chernozems, *Infiltration, *Soil water, Absorption, Water balance, Analytical techniques, Porests, Vegetation effects, Geology, Land use, Permeability. Identifiers: *USSR, Chernozem Provinces.

Infiltration properties of virgin land, cultivated land, forest and forest belt of the Chernozem region of the USSR were experimentally investigated. Chernozem soils have the highest infiltration capacity of the region and light-gray forest soils have the lowest. The greatest beneficial effect on infiltration is exerted by the forest and vegetation cover of virgin land areas. Grazing by cattle greatly impairs the infiltration properties of the soils both on cultivated land and in the forest. Forest belts exert a considerable beneficial influence on the soil by increasing its infiltration capacity. (See also W70-09312) (Gabriel-USGS) W70-09313

AN APPROXIMATE METHOD FOR DETERMINING THE HYDRAULIC CONDUCTIVITY FUNCTION OF UNSATURATED SOIL,

Purdue Univ., Lafayette, Ind. Water Resources Research Center.

Available from NTIS as PB-193 673, \$3.00 in paper copy, \$0.65 in microfiche. OWRR Project A-010-IND (6). R. W. Skaggs, E. J. Monke, and L. F. Huggins

Descriptors: *Hydraulic conductivity, *Soil physical properties, Water properties, *Unsaturated flow, Non-saturated flow, *Pressure head, *Infiltration, Soil moisture, Soil water movement, Water

Identifiers: Richard's equation, Soil moisture characteristic.

A method is proposed for determining the hydraulic conductivity function of unsaturated soil. The method is based on the assumption that the conductivity-pressure head relationship, K (h), can be effectively represented by an empirical three-parameter equation. Procedure are given for evaluating the equation parameters from measure-ments of the soil-water characteristic, the saturated conductivity, and the infiltration rate-time relationship for an initially dry soil. Repeated numerical solutions to the Richard's equation for the movement in unsaturated soil are used with a search procedure to determine the parameter values giving the minimum difference between measured and calculated infiltration rate-time relationships. Computer programs, written in FORTRAN, were developed to apply and evaluate the method. An evaluation of the proposed method using soil pro-perty data obtained from the literature showed that a good approximation of the conductivity data could be obtained for soils in which the conductivity function had the general form of the assumed relationship. For soils having other forms of K (h), the functions obtained still allowed accurate predictions of the infiltration rate-time relationship for a wide range of initial water contents. W70-09342

THE EFFECT OF TEMPERATURE ON WATER FLOW IN SOILS,

Mississippi State Univ., State College. Water Resources Research Inst.

A. D. Jensen, M. Haridasan, and G. S. Rahi. Available from NTIS as PB-193 676, \$3.00 in paper copy, \$0.65 in microfiche. Completion Re-port, Water Resources Research Institute, June, 1970. 43 p, 2 tab, 9 fig, 40 ref. OWRR Project B-002-MISS (1). R. D. Jensen, M. Haridasan, and G. S. Rahi.

Descriptors: *Hydraulic conductivity, Pressure head, *Soil water movement, *Diffusivity, Soil moisture, *Temperature, Soil temperature, Thermal conductivity, *Conductivity. Identifiers: Flux equations.

Group 2G—Water in Soils

The dependence of the hydraulic conductivity of soil, the pressure head of soil water, and the soil water diffusivity on temperature, was investigated to determine the possible influence of temperature on water flow in soils. The hydraulic conductivity was found to be a function primarily of the soil water content. The effect of temperature on conductivity as a function of pressure head resulted primarily from the influence of temperature on the water content. At 35C the conductivity was larger at saturation, the soil drained at a larger pressure head, and the conductivity decreased at a faster rate than at 15C. Near saturation, when the water contents at the two temperatures were nearly the same, the increase in conductivity associated with rise in temperature can be explained by the effects of temperature on the viscosity of water. The pressure head as a function of water content increased as the temperature increased. This increase can be accounted for by the temperature dependence of the surface tension of air-water interfaces. The amount of water held by the soil at any given pressure head decreased with a rise in temperature. The effect of temperature on the diffusivity as a function of water content and pressure head was not significant except near saturation. The temperature dependence of the viscosity of water is sufficient to account for these effects. Techniques to resaturate a soil column, which avoided the difficulties caused by hysteresis, were developed so that repeated measurements of all the desired parameters could be made on the same sample of soil. Flux equations with measurable parameters which seem to adequately describe the flow of water and heat under nonisothermal conditions were presented. W70-09345

EVALUATION OF SOIL MOISTURE MEA-SUREMENTS IN OKLAHOMA AS SOIL SUREMENTS IN OKLAHOMA AS SO CHARACTERISTICS FOR CLASSIFICATION,

Agricultural Research Service, Stillwater, Okla.; and Oklahoma State Univ., Stillwater. Dept. of

D. Nichols, and J. F. Stone.

Soil Science Society of America Proceedings, Vol 34, No 4, p 638-641, July-August 1970. 4 p, 2 fig, 1 tab, 11 ref.

Descriptors: *Soil moisture, *Soil moisture meters, *Nuclear moisture meters, *Soil classifications, Instrumentation, On-site tests, Soil analysis, Soil investigations, Soil science, Soil types, Drying, Evaporation, Oklahoma.

Identifiers: Neutron moisture meters.

Soil moisture measurments were evaluated as soil moisture characteristics specified in the new soil classification system. Soil moisture measurements were made with a neutron probe at about weekly intervals and were available for 3 to 6-year periods at four sites with a range in mean annual precipitation of 45 cm to 80 cm. The cumulative days were counted when the soil moisture was below minus 15 atm pressure in either or both of the 0 to 23-cm increment and the 23 to 38-cm increment. The count was also made for the control section of the 23 to 38-cm increment and the 38 to 53-cm increment. The data yielded close fitting linear regression lines for cumulative days dry in each year against the measured precipitation for that year. The regression lines for the two tested control sections were nearly alike. The neutron probe method seems to be a satisfactory method for determining days dry. Some adjustment of the data may be necessary in translating the data for use in the classification system. (Knapp-USGS)
W70-09377

INFLUENCE OF RAINFALL ENERGY ON SOIL LOSS AND INFILTRATION RATES: 2. effect of

clod size distribution,
Agricultural Research Service, Ames, Iowa; and Iowa State University, Ames. W. C. Moldenhauer.

Soil Science Society of America Proceedings, Vol 34, No 4, p 673-677, July-August 1970. 5 p, 7 tab,

Descriptors: *Soil erosion, *Runoff, *Rainfall-runoff relationships, *Impact (Rainfall), Laboratory tests, Model studies, Simulated rainfall, Raindrops, Soil structure, Soil physical properties. Identifiers: Soil clod failure, Clods.

Various cold size distributions were subjected to drop impact from a water drop applicator that delivered only 5-mm drops. Increasing the maximum clod size from 20 to 40 mm did not delay the time for runoff to begin on four silt loam to silty clay textured Iowa soil samples taken from continuous-corn plots. Removing the clods smaller than 2 mm from the smaller than 40-mm sample had little effect on the time to runoff on continuous-corn soils, but did increase the time to initial runoff on the silt loam soil from meadow. Removing the fraction smaller than 8 mm from the smaller than 40mm sample significantly increased the rainfall energy required to initiate runoff in all instances tested. Removing the fraction smaller than 30-mm from the smaller than 40-mm sample nearly doubled the energy to initial runoff. However, clod beds of this 30- to 40-mm size range from continuous corn did not withstand 0.18 joules per sq cm of rainfall energy, which commonly occur in western Iowa during the critical erosion period. Clod beds of the 30- to 40-mm size range from continuous meadow, in contrast to clod beds from corn land, did withstand 0.18 joules per sq cm of rainfall energy. (Knapp-W70-09378

SOIL TEMPERATURE AND WATER CONTENT CHANGES DURING DRYING AS INFLUENCED BY CRACKS: A LABORATORY EXPERIMENT, Iowa State Univ., Ames.

H. M Selim, and Don Kirkham.

Soil Science Society of America Proceedings, Vol 34, No 4, p 565-569, July-August 1970. 5 p, 6 fig, 2 tab, 7 ref. OWRR Project A-026-IA.

Descriptors: *Evaporation, *Soil water, *Expansive soils, *Cracks, Drying, Unsaturated flow, Soil water movement, Winds, Soil temperature, Soil structure, Soil physical properties, Laboratory

Identifiers: Soil shrinkage cracks.

A container consisting of three identical compartments each 30 cm long, 30 cm deep, and 10 cm wide, was used to study the influence of artificial soil shrinkage cracks on heat and water content redistribution in three soil materials subjected to wind or radiative drying at 1.18 and 2.54 cm of water per 24 hours. Crack widths of 0, 0.64, and 1.91 cm were tested. Moisture content and temperature distributions were measured with time up to 12 days. The cracks decreased water content as much as 5 to 10% by volume. Evaporation through crack walls caused lateral movement of water for a distance of 4 to 5 cm from the wall of a 0.64-cm crack after 12 days of radiative drying. These distances were greater up to 14 cm in sand. Under wind, distances of lateral movement of water were about 5 cm for all drying times. In all three soils with cracks, after 4 days of wind drying soil temperature was cooler (1 to 2C lower) than for the soils with no cracks. Under radiation all three soils were warmer (5 to 10C higher) than soils with no cracks, after 4 days. In general, shrinkage cracks increased evaporation from bare soil 12-16% with cracks 0.64 cm wide and about 30% with cracks 1.91 cm wide as compared to evaporation from soils with no cracks. (Knapp-USGS) W70-09379

FREEZING AND THAWING EFFECTS ON DRAINAGE.

Agricultural Research Service, Burlington, Vt. Soil and Water Conservation Research Div. G. R. Benoit, and J. Bornstein.

Soil Science Society of America Proceedings, Vol 34, No 4, p 551-557, July-August 1970. 7 p, 7 fig, 6 tab, 22 ref.

Descriptors: *Soil water movement, *Frost, *Frozen soils, *Freezing, *Thawing, Melting, Percolation, Infiltration, Drainage, Soil structure, Soil physical properties, Particle size, Clays, Soil texture, Laboratory tests.
Identifiers: Soil water-frost relationships.

Laboratory studies were conducted on insulated models containing coarse sand (1-2 mm), fine sand (0.5-1 mm) and soil (0-2 mm and 2-4.8 mm) to determine the effects of freezing and thawing on sloping land drainage. Relations between structure and texture, rates and extent of ice formation, and rates and magnitudes of drainage were determined. Decreasing temperatures and subsequent ice formation decreased the relative mobility of water, thereby increasing water retention and decreasing rates of water transmission. The magnitude of the short-term, freeze-thaw effects on soil water retention and transmission was influenced by soil aggregate size, aggregate stability, and soil water content during freezing. On a long-term basis, drainage that results in a consistently lower water content during freeze-thaw cycles may lead to a changed soil structure and thus a changed drainage requirement. (Knapp-USGS) W70-09380

A GAMMA-PHOTONEUTRON METHOD FOR LABORATORY STUDIES OF SOIL WATER, Du Pont de Nemours (E. I.) and Co., Aiken, S.C. J. C. Corey, R. H. Hawkins, and R. F. Overman.

Soil Science Society of America Proceedings, Vol 34, No 4, p 557-560, July-August 1970. 4 p, 3 fig, 1 tab, 13 ref. USAEC Contract AT (07-2)-1.

Descriptors: *Nuclear moisture meters, *Soil moisture meters, Deuterium, Heavy water, Nuclear meters, Bulk density, Soil texture, Laboratory tests, Instrumentation. Identifiers: Photoneutron meters.

Using the gamma-photoneutron method, the heavy water content of laboratory soil columns can be measured independently of bulk density of soil, soil texture, light water content, and type of clay mineral. The method requires a radioactive source that emits gamma photons in excess of 2.23 Mev and a neutron detector. The neutron detector measures photoneutrons produced when the deuterium nuclei in the gamma radiation field split into a photoneutron and a proton. The number of photoneutrons detected is linearly related to the heavy water content of the soil column. (Knapp-USGS) W70-09382

MEASUREMENT OF WATER POTENTIAL AND OSMOTIC POTENTIALS IN SOIL WITH A COMBINED THERMOCOUPLE PSYCHROMETER AND SALINITY SENSOR,

Agricultural Research Service, Riverside, Calif. Salinity Lab.

R. D. Ingvalson, J. D. Oster, S. L. Rawlins, and G. J. Hoffman.

Soil Science Society of America Proceedings, Vol 34, No 4, p 570-574, July-August 1970. 5 p, 5 fig, 2 tab, 9 ref.

Descriptors: *Soil moisture meters, *Water chemistry, *Osmotic pressure, Instrumentation, Soil-water-plant relationships, Moisture stress, Salinity, Wetting, Drying, Laboratory tests. Identifiers: Soil water chemistry, Matric potential, Psychrometers.

A combined thermocouple psychrometer and salinity sensor, which is embedded in a single ceramic body, is described. This design makes possible the measurement of the water and osmotic potentials of soil water at the same location in the soil. Errors produced by spatial variations in soil solution concentration, shown to be large, were eliminated by the instrument's ability to make both measurements on a single sample of soil solution. The instrument was tested in a soil-plant-water system, and the data obtained are reported.

Water in Plants—Group 21

Desaturation of the ceramic at matric potentials more negative than -2 bars was shown to have a significant effect on conductance of the salinity sensor. Correction for this effect is discussed. Measurements showed that cotton plants extracted more water from the less saline zones in the soil. This had the effect of lowering the water potential to approximately the same value at two depths in the soil profile at the end of a drying cycle. (Knapp-USGS) W70-09384

2H. Lakes

FACTORS AFFECTING THE MOVEMENT OF WATER AND ORGANISMS WITHIN A REGU-LATED MULTIPURPOSE LAKE,

Washington State Water Research Center, Pull-

Gerald F. Kraft, and David T. Mason. Available from NTIS as PB-193 680, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, July 29, 1970. 17 p, 4 fig.

Descriptors: Lakes, Lake shores, Multiple-purpose reservoirs, Limnology, Thermal properties, E. coli, Density currents, Washington. Identifiers: Lake Whatcom.

Lake Whatcom, in northwest Washington, occupies a glaciated former stream valley. It is an elongate multipurpose lake, 12 miles long and averaging 3/4 mile in width, of considerable depth (150 feet average), and is moderately eutrophic. A 40inch pipeline delivers glacial melt water from the Middle fork of the Nooksack River 20 miles away to the southeast extremity; the outflowing stream and domestic water-supply pipeline (city of Bellingham) are at the northwest end. Surface current patterns induced by wind have been identified within the lake and have been reproduced in a fiberglas 1:2400-scale model. It was found that thermal barriers reduce daily the intermixing of surface waters between the major depressions in the lake. Near-shore patterns of these thermal barriers were correlated with an observed 10-fold increase in bacterial concentration between the fifteenth and first meter off-shore. A study was made of the survival time of the bacteria Escherichia coli, Staphylococcus aureus, unidentified lake isolates, and the blue-green alga Haematococcus lacustris, under various light intensities and in variously treated aged lake water. It was tentatively concluded that the rate of bacterial activity increased in the presence of phytoplankton, under specific light-intensity conditions. An analysis of littoral vegetation distribution has resulted in the identification of three communities. (Kraft-Washington State) W70-09090

WATER QUALITY IN RELATION TO PRODUCTIVITY OF LAKE ASHTABULA RESERVOIR IN SOUTHEASTERN NORTH DAKOTA,

North Dakota Water Resources Research Inst.,

Fargo. For primary bibliographic entry see Field 5C. W70-09093

MONTHLY MEAN SURFACE TEMPERATURES FOR LAKE ONTARIO AS DETERMINED BY AERIAL SURVEY, Meteorological Service of Canada, Toronto (On-

Michael S. Webb.

Water Resources Research, Vol 6, No 3, p 943-956, June 1970. 14 p, 18 fig, 2 tab, 18 ref.

Descriptors: *Lake Ontario, *Evaporation, *Water temperature, *Surveys, *Remote sensing, Infrared radiation, Humidity, Solar radiation, Mass transfer, Mapping, Great Lakes.
Identifiers: Water surface temperature.

perature curve has been produced for each point.
Values for the middle of each month have been determined by interpolation, and used to produce a pattern for each month. (Knapp-USGS) W70-09206 WATER BUDGET OF UPPER KLAMATH LAKE SOUTHWESTERN OREGON, Geological Survey, Washington, D.C. Larry L. Hubbard. For sale by US Geological Survey, Washington, DC 20402 - Price \$0.50. US Geological Survey Hydrologic Investigations Atlas HA-351, 1 sheet, 1970. Text, 1 fig, 1 map, 4 graph, 1 tab, 5 ref.

Descriptors: *Lakes, *Oregon, budget, *Water balance, Streamflow, Springs, Precipitation (Atmospheric), Discharge (Water), Water storage, Water level fluctuations, Water storage, Water leve Evapotranspiration. Identifiers: Klamath Lake (Oreg).

For calculations of evaporation losses by mass transfer techniques, and for many other research

and operational applications, it is necessary to

know the mean patterns of surface water tempera-

ture. Preliminary patterns of monthly mean surface

water temperatures are presented for Lake On-

tario, based on 36 airborne radiation thermometer

surveys over a three-year period. Temperature

values at each of the 89 points in a grid have been

plotted against calendar date, and an annual tem-

A 1-sheet hydrological atlas presents a quantitative water budget for Upper Klamath Lake. It includes an inventory of water entering and leaving the lake and changes in lake storage for the 3-year period Oct. 1, 1964, to Sept. 30, 1967. Upper Klamath Lake, just east of the Cascade Range and about 17 miles north of the California State line, has a drainage area of 3,810 sq mi and is the largest lake in Oregon. It is about 22 mi long, with about 165 mi of shoreline and a mean depth of about 8 ft. Depths reach 40 to 50 ft in a narrow strip of the lake between Eagle Ridge and Bare Island. Mean annual precipitation is 14 inches at Klamath Falls at the south end of the lake and 18 inches at Chiloquin near the northeast end of the lake. Much of the precipitation in the lake area falls as snow from November through March. Average annual lake evaporation is about 40 inches. Surface inflow provided 79% of the total inflow to the lake. Precipitation falling directly on the lake provided 7% of the total inflow. Surface outflow constituted 84% of the outflow from the lake. Over the 3-year study period, evapotranspiration accounted for the remaining 16% of the total outflow. During the period of the study there was slight net decrease in lake storage. (Knapp-USGS) W70-09250

WATER BALANCE AND SILTING OF SMALL RESERVOIRS IN THE CENTRAL CHERNOZEM OF THE RUSSIAN SOVIET FEDERAL SOCIALIST REPUBLIC.

For primary bibliographic entry see Field 02J. W70-09312

ELEMENTS OF THE WATER BALANCE OF SMALL RESERVOIRS OF THE CENTRAL CHERNOZEM PROVINCES,

I. N. Sorokin.

Translated from Russian. In: Water Balance and Silting of Small Reservoirs in the Central Cher-nozem of the Russian Soviet Federal Socialist Republic, US Agricultural Research Service, p 107-143, 1967, 37 p, 4 fig, 8 tab, 26 ref.

Descriptors: *Water balance, *Reservoirs, *Ponds, *Chernozems, Surface waters, Groundwater, Discharge (Water), Irrigation, Seepage, Evaporation, Runoff, Rivers, Mapping, Seasonal, Floods, Precipitation (Atmospheric), Gaging stations. Identifiers: *USSR, Chernozem Provinces.

The water balance and hydrological regime of small reservoirs and ponds of the Chernozem

Provinces of the USSR were experimentally investigated by collecting and analyzing inflows of surface water, annual runoffs, winter floods, precipitation, evaporation, and seepage data. A comparison of the mean surface runoffs in spring of small rivers and intermittent watercourses with previously made maps shows that in many cases these values are in close agreement. Winter floods occurred in seven of the ten winters of 1950 to 1959, In the northern part of the Chernozem province evaporation losses are about 20% of the normal volume of ponds. In the Karsk Province and the Voronezh Province they are 40 and 50%, respectively. Seepage changes are affected by the fluctuations of reservoir water levels. (See also W70-09312) (Gabriel-USGS) W70-09314

THE BALANCE METHOD OF COMPUTING SEDIMENT FLOW AND ESTIMATING THE RATE OF SILTING OF RESERVOIRS, For primary bibliographic entry see Field 02J. W70-09315

2I. Water in Plants

AN ENERGY BUDGET STUDY ABOVE THE FOREST CANOPY AT MARMOT CREEK, AL-

BERTA, 1967, Meteorological Service of Canada, Calgary (Al-

For primary bibliographic entry see Field 02D. W70-09111

WATER USE BY SALT CEDAR,

Geological Survey, Lubbock, Tex.; and Texas Tech Univ., Lubbock

For primary bibliographic entry see Field 02D. W70-09113

FACTORS AFFECTING SEED GERMINATION UNDER SOIL MOISTURE STRESS,

National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.

Israel Journal of Agricultural Research, Vol 20, No 1, p 3-14, Jan 1970. 6 fig, 2 tab, 12 ref.

Descriptors: *Seeds, *Germination, *Moisture stress, *Soil moisture, *Diffusivity, Arid lands, Semiarid climates, Plant growth, Vegetation establishment, Soil-water-plant relationships, Environmental effects, Viability, Moisture availabili-

ty, Clovers. Identifiers: *Israel, *Chickpeas.

Factors intrinsic to the seed, to the soil, or to both seed and soil may inhibit germination of seeds under soil moisture stress. The relative importance of such factors was evaluated, including soil moisture potential, soil moisture diffusivity, water diffusivity of seeds, and characteristics of the seedsoil interface. Experimental results from chickpea (Cicer arietinum L. local variety) and clover (Trifolium alexandrinum L. var. Musgawi) suggested that germinating seed can be supplied with soil moisture at a rate equal to or greater than the capacity of the seed to absorb it. Both the amount of water actually absorbed by the seed and the subsequent germination rate depended on the adaptability of the internal moisture potential of the seed and on the real potential at the seed-soil interface. In this experiment it also appeared that the effective stress of the soil matrix had little, if any, influence on germination. (Carr-Arizona) W70-09135

THE EFFECT OF SOIL MOISTURE LEVEL OF THE INCIDENCE OF EARLY BLIGHT ON POTATO AND TOMATO PLANTS,

National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research. I. Rotem.

Group 21—Water in Plants

Israel Journal of Agricultural Research, Vol 19, No 3, p 139-141, July 1969. 1 tab, 1 fig, 4 ref.

Descriptors: *Potatoes, *Tomatoes, *Blights, *Soil moisture, *Turgidity, Plant diseases, Infection, Disease resistance, Environmental effects, Arid climates, Arid lands, Irrigation effects, Irrigation, Irrigation programs, Moisture uptake, Soil water, Field crops, Crop production, Leaves, Soil-waterplant relationships.

Identifiers: *Early blight, *Israel, *Negev Desert, *Irrigated agriculture, Flowers.

Potted potato and tomato plants were inoculated with Alternaria porri f. sp. solani and studied to see what effect various soil moisture levels would have on the incidence of early blight. High levels of soil moisture before inoculation were found to be associated with increased susceptibility to the disease. Higher moisture levels were also directly related to increased yield/foliage weight ratio, which is a known predisposing factor for early blight. In half of the tomato plants the effect of different yield/foliage weight ratios resulting from various irrigation treatments was nullified by removing the flowers. For these plants, low soil moisture level was associated with the highest degree of infection (LSD = 5 percent). In the experiment with potatoes, increased leaf turgidity resulted in greater susceptibility to blight in all of the irrigation treatments. It would appear that the increased susceptibility of tomatoes and potatoes to early blight when grown at high soil moisture levels is due to the high yield/foliage weight ratio, which is in turn associated with a lowering of the resistance mechanism. (Carr-Arizona)
W70-09137

THE STABILITY OF WHEAT EMBRYO GLU-TAMATE DECARBOXYLASE UNDER CONDI-TIONS OF WATER STRESS,

Texas Univ., Arlington. Dept. of Biology. Claude Nations.

Canadian Journal of Botany, Vol 45, No 11, p 1917-1925, Nov 1967. 3 fig, 2 tab, 17 ref.

Descriptors: *Wheat, *Drought *Moisture stress, *Enzymes, *Plant physiology, Proteins, Lipids, Molecular structure, Drought tolerance, Germination, Embryonic growth stage, Semiarid climates.

Identifiers: *Glutamate decarboxylase, *Seedlings.

The stability of glutamate decarboxylase in wheat embryos and seedlings (Triticum aestivum L. variety concho) was studied in an attempt to obtain information suggesting a molecular basis for plant drought resistance. Decarboxylase activities in germinating wheat grains were measured before and after drying and an effort was made to relate enzyme activity to a soluble or particulate cell fraction by differential centrifugation. Active protein preparations were subjected to defatting treatments with n-butanol and then their responses to drying were measured. While decarboxylase activity in germinating wheat increased for 54 hr, enzyme stability decreased during this period. No activity could be detected in particulate cell fractions. The responses to desiccation by the extracted enzyme suggest that the stability of decarboxylase may lie in its ability to dissociate into smaller protein components when under moisture stress. It appears that this ability may depend upon the presence of lipids, which might be the source of a reversible association between enzyme com-ponents. (Carr-Arizona) W70-09138

EFFECT OF SOIL PROFILE TYPE AND FER-TILIZER ON MOISTURE USE BY WHEAT GROWN ON FALLOW OR STUBBLE LAND, Saskatchewan Univ., Saskatoon. Dept. of Soil

For primary bibliographic entry see Field 03F. W70-09139

EFFECT OF VARIATIONS IN SUBSTRATE SALINITY ON THE WATER BALANCE AND IONIC COMPOSITION OF BEAN LEAVES,

National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research; and Hebrew Univ., Jerusalem (Israel). Dept. of Botany. A. Meiri, and Alexandra Poljakoff-Mayber.

U.S. Department of Agriculture Grant No. FG-IS-179. Israel Journal of Botany, Vol 18, No 3, p 99-112, 1969. 5 fig, 1 tab, 34 ref.

Descriptors: *Halophytes, *Osmotic pressure, *Water balance, *Salt tolerance, *Water potential, Turgidity, Soil-water-plant relationships, Chlorides, Cations, Anions, Conductivity, Leaves, Sodium, Potassium, Calcium, Magnesium. Identifiers: *Glycophytes, *Osmotic adjustment, *Relative water content, *Cell sap, Refractive in-

dex, Block design, Hoagland culture solution, Trifoliate leaves, Split-plot design.

Studies on glycophytes and halophytes in saline solutions have shown that osmotic adjustment takes place through ionic absorption and resulting increased water uptake. These experiments differed from actual field conditions in that the salinity levels were constant. Bean seedlings (Phaseolus vulgaris) were exposed to increasing NaCl concentrations, up to-2.8 atmospheres, over varying increments of time. The increasing salinities caused a reduction in water potential accompanied by a slower reduction in osmotic potential (OP) and consequent reductions in relative water content and tissue turgor (P). Sap concentrations, both metabolites and ions increased. The inorganic increas, especially chloride, was most prominent. This in turn caused increased P, which levelled off at final constant salinity. The sap OP decreased less rapidly than the external solution while tissue water potential decreased more rapidly than either. These effects were proportional to salinity rates of change. Adjustments to constant salinity resulted from gradual ion accumulation. The bean plant is therefore capable of adjusting its water balance depending on the rate of change of salinity and tissue age. (Casey-Arizona) W70-09144

PHYSIOLOGICAL RESPONSES TO TEMPERA-TURE AND DESICCATION IN THE ENDEMIC MEXICO PLETHODONTIDS. PLETHODON NEOMEXICANUS AND ANEIDES HARDII.

New Mexico State Univ., University Park. Dept. of Biology. Walter G. Whitford.

NASA Grant NGR 32-003-27. Copeia, No 2, p 247-251, June 5 1968. 2 fig, 4 tab, 13 ref.

Descriptors: *Salamanders, *Physiological ecology, *Moisture stress, New Mexico, Ecology, Animal behavior, Distribution patterns, Amphibians, Circulation (Animals), Oxygen requirements,

Respiration, Semiarid climates, ldentifiers, *Critical thermal maxima, *Oxygen consumption, *Tissue de siccation, *Heart rate, Relict species, Critical activity point, Temperature-metabolism curves.

The physiological parameters, oxygen consumption, desiccation limits, and critical thermal maxima (CTM) are valuable in interpreting ecological relationships and distributions of Plethodon neomexicanus and Aneides hardii are 2 relict species of plethodontid Salamanders in the Jemez Mountains of New Mexico. The mean CTM of both species are almost identical and similar to that of a relative living in cold mountain streams of southern Appalachia. This probably reflects adaptations to their cold microhabitat. Thermetabolismtemperature curves differed and were probably related to differences in respiratory surface area since cutaneous gas exchanged accounts for 75-90 percent of total oxygen consumption in plethon-tids. Differences in desiccation rates may be due to differences in behavior while in the dessication chamber. P. neomexicanus is similar to other western species in having a higher tolerance to desiccation than eastern plethodons. This together with the requirement of fairly low, ambient temperatures to obtain sufficient metabolic oxygen indicates a dispersal from the east, across Oklahoma to New Mexico, possibly during the Pleistocene. (Casey-Arizona) W70-09145

MINERAL METABOLISM OF HALOPHYTES,

California Univ., Davis. Dept. of Soils and Plant t Nutrition

Emanuel Epstein.

Supported by grants from the Office of Saline Water, U.S. Department of the Interior. In: Ecological Aspects of the Mineral Nutrition of Plants, Blackwell Scientific Publications, London, p 345-356, 1969. 3 fig, 22 ref.

*Halophytes, *Salt tolerance, ssure, *Water balance, *Carriers, *Salt tolerance, Descriptors: *Osmotic pressure, *Water balance, *Carriers, Sodium, Chlorides, Potassium, Arid lands, Turgidity, Water stress, Soil-water-plant relationships, Cal-

Identifiers: *Mineral metabolism, *Glycophytes, *Osmotic adjustment.

Halophytes are a varied flora of oceans, other salty waters and arid and semi-arid lands. Within the general limits of all plants they (1) Are salt-tolerant (2) Selectively acquire essential elements and water, often against high concentration gradients (3) Block excessive ion uptake which would interfere with cellular metabolic mechanisms or tissue osmotic potentials. Carriers in the cell membrane operate to selectively absorb certain ions. For a given ion, 2 types of carrier probably exist. One operates at low external concentrations up to 0.5 mM, excluding other ions. It occurs in both halophytes and salt-sensitive plants. The second type operates at high external concentrations, in some cases greater than 50 mM. Both leaf and long-term experiments with Atriplex and Agropyron species verify the second type crucial in halophytes. Selective ionic absorption causes an equilibration of external and tissue osmotic pressures resulting in a plant water potential that maintains adequate tissue turgor. Salt glands and succulence are 2 other salt-tolerance mechanisms occurring in some halophytes. (Casey-Arizona) W70-09147

HEART RATE AND CHANGES IN BODY FLUIDS IN AESTIVATING TOADS FROM XERIC HABITATS,

New Mexico State Univ., University Park. Dept. of Biology

Walter G. Whitford.

National Aeronautics and Space Association Grant NGR-32-003-27. In: Physiological Systems in Semiarid Environments, University of New Mexico Press, p 125-133, 1969. 5 fig, 7 ref.

Descriptors: *Toads, *Aestivation, *New Mexico. *Xerophilic animals, *Physiological ecology, Physiology (Animal), Environmental effects, Metabolism, Mode of action, Moisture stress, Oxygen requirements, Respiration, Water balance, Ureas, Chlorides, On-site investigations, Arid lands, Laboratory investigations.

Identifiers: *Body fluids, *Fossorial animals, Bradycardia.

Three species of fossorial New Mexican toads, Scaphiopus hammondi Bufo punctatus and Bufo cognatus, survive desiccating desert conditions by aestivating in their burrows for 10 months a year. The gross metabolic factors of heart rate and body fluids were measured in both aestivating and non-aestivating specimens. Heart rates as measured by aestivating specimens. Heart rates as measured by electrocardiograms decreased 4-6 fold with number of days burrowed. Recently surfaced animals had control level heart rates. This bradycardia associated with aestivation is probably a reflection of reduced metabolism. Importantly, reductions in both heart rate and metabolism were temperature-independent. Body fluid chlorides showed a small increase, hemoglobin a small

Erosion and Sedimentation—Group 2J

decrease, and urea doubled. The urea increase was expected because it is a major fossorial anuran water conservation mechanism in xeric habitats. (Casey-Arizona) W70-09148

WATER ECONOMY OF THE GREEN-TAILED TOWHEE (CHLORURA CHLORURA),
Arizona Univ., Tucson. Dept. of Biological

E. Linwood Smith, and Robert D. Ohmart.
In: Physiological Systems in Semiarid Environments, University of New Mexico Press, p 115-124, 1969. 4 fig, 10 ref.

Descriptors: *Birds, *Moisture stress, *Physiological ecology, Arid lands, Arizona, Water balance, Animal behavior, Animal physiology.

Identifiers: *Green-tailed Towhees, Water econo-

Two crucial water economy adaptations in desert animals are the relative abilities to tolerate dehydration and to utilize saline drinking water. The Green-tailed Towhee winters in southern Arizona but is not a resident or desert bird. It was shown it needs 3-5 milliliters of water per day to maintain its body weight and could discriminate between distilled and salt water. Expressed as precentage of body weight, the distilled water drank by 10 adults (68.2) was significantly greater than 0.1M Na Cl solution (58.5). Similarly daily body weight fluctuations were only significant with 0.1 and 0.2 M NaCl. Of 20 birds tested on 0.25 M NaCl solution, half died in 6 days and 7 survived 18 days with little weight loss. Of these, 4 survived on 0.3M NaCl and 1 on 0.35 M NaCl. No enlarged nasal salt glands were found on those dying from 0.3-0.35M NaCl. The appearance of 2 intraspecific groups with respect to 0.25M NaCl solution utilization could not be explained with present data. Possibilities are: (1) Individual variation (2) Evolution of a physiological subspecies (3) Derivation from a xerically-adapted parental stock. The water economy efficiency of small desert birds has been shown to be greater than that of the Green-tailed Towhee. (Casey-Arizona) W70-09149

THE ROLE OF VEGETATION IN SOIL WATER

PROBLEMS, Rothamsted Experimental Station, Harpenden (England). H. L. Penman.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 49-61, 1968. 13 p, 2 fig, 1 tab, 26 ref.

relationships, *Soil-water-plant *Evapotranspiration, *Evaporation, Vegetation effects, Water balance, Soil water movement, Moisture tension, Humidity, Root distribution, Root zone, Soil moisture, Permeability, Weather. Identifiers: *Potential evaporation, Potential evapotranspiration.

The main mechanism for producing unsaturation is evaporation from growing plants. In some clay soils the drying produces cracks whose persistence may determine soil permeability at saturation. Movement of water, and limiting values of soil water contents, are determined by soil moisture potentials, and energy supply is rarely a controlling factor. The lower limit of water content depends on the depth of root penetration, and the degree of ramisfication within the root depth: plant and soil characters determine these quantities. Adding the concept of accessibility to that of availability reconciles some clashes in field evidence about how long actual evaporation remains equal to potential evapora-tion. Examples of plant/soil interactions considered include a range of soil depths, contrasts in plant type and different climates. (See also W70-09263). (Knapp-USGS)
W70-09262

A STUDY OF THE AQUATIC ECOSYSTEMS IN TWO NATIONAL WATERFOWL REFUGES IN MISSISSIPPI,

Mississippi State Univ., State College. Water Resources Research Inst.

Dale H. Arner, Earl D. Norwood, and Billy M.

Available from NTIS as PB-193 677, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, Water Resources Research Institute, June 1970. 32 p. OWRR Project A-036-MISS.

*Aquatic environment, *Aquatic Descriptors: animals, *Wood duck, *Ecosystems, *Invertebrates, *Waterfowl, Phytoplankton, Mississippi, Soils, Dissolved solids, Water chemistry, Soil chemistry.

Identifiers: Noxubee national waterfowl refuge, Yazpp national waterfowl refuge.

A study was made of the aquatic ecosystems of the Yazoo and Noxubee national waterfowl refuges in Mississippi. This study revealed the following: (1) Soils of the Yazoo refuge were higher in potash and less acid than the Noxubee soils. (2) Water analysis revealed that the water of the Yazoo refuge had greater concentration of several important dissolved solids and more carbon dioxide than the Noxubee refuge. (3) Phytoplankton concentrations were greater in the Yazoo refuge. (4) During the late winter and early spring season a larger biomass of invertebrates was found in the aquatic plant communities of the Yazoo refuge. (5) The mean clutch size of wood ducks using artificial nesting boxes in the Yazoo refuge was higher than in the Noxubee refuge. W70-09346

PADDY RATOONS,

Institute of Agricultural Research, Addis Ababa For primary bibliographic entry see Field 03F. W70-09501

2J. Erosion and Sedimentation

TRACER STUDIES ON THE MOVEMENT OF SAND AND GRAVEL,

Kyoto Univ. (Japan). Katsumasa Yano, Yoshito Tsuchiya, and Masanori

13th Congr Int Assn. Hydraul Res, Proc Vol 2, p 121-129, Aug-Sept 1969. 9 p, 6 fig, 11 ref.

Descriptors: *Sediment transport, Sediment discharge, Sedimentation, Bed load, *Tracers, Sands, Gravels, *Mathematical models, *Laboratory tests, Stochastic processes, Equations, Foreign

research, Color. Identifiers: *Stochastic models, *Bedload move-ment, Particle velocity, Formulas, Empirical equations, Japan, Hydrologic models.

xperiments using colored sand and gravel as tracers in a laboratory flume show that irregular and intermittent movement of sand and gravel in a stream can be simulated by a stochastic model. The stochastic model and experimental results show that the distribution of traveling distance of a single step of sand grains can be described by an exponential function. Relations between the average traveling distance of a single step and the probability for the beginning of movement of sand grains per unit time, and the parameter of flow intensity are discussed. Empirical formulas based on the tracer experiments are proposed for estimating average traveling velocity and bedload discharge of sand and gravel for the regime of flat beds. (USBR) W70-09024

AN ELECTRO-OPTICAL PROBE FOR MEASUREMENT OF SUSPENDED SEDIMENT CON-CENTRATION,

Iowa Univ., Iowa City. Protosh K. Bhattacharya, John F. Kennedy, and John R. Glover.

13th Congr Int Assn. Hydraul Res, Proc Vol 2, p 241-250, Aug-Sept 1969. 10 p, 6 fig, 2 ref.

Descriptors: Sediment concentration, *Sediment load, Sediments, Light waves, Sediment transport, *Suspended sediments, Measuring instruments, *Optical instruments, Optical properties, Turbidity, Light penetration, Instrumentation, Sedimenta-

Identifiers: Probes (Instruments), Optical measurements, Light beams, *Light-scattering method, Photometers.

newly developed instrument for measuring suspended sediment concentration in situ in rivers, estuaries, and shoaling waves is described. The probe has a gallium arsenide diode as a light source and a silicon planar diode as a light sensor. The light is attenuated by the suspended sediment concentration; light attenuation is proportional to the sediment surface area per unit volume of the suspension, resulting almost exclusively from light scattering at particle surfaces. Probe circuitry and appurtenant instruments are described, and calibration and response characteristics are given. Frequency response is adequate for measuring turbulent fluctuations and periodic variations of sediment concentration. Some data obtained in steady uniform flow and in breaking waves are summarized. (USBR) W70-09026

REDUCTION OF SEEPAGE LOSSES FROM IR-RIGATION CANALS AS A RESULT OF SILT-ING.

Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 03F. w70-09043

THE EFFECT OF BED-LOAD MOVEMENT ON THE VELOCITY DISTRIBUTION OF FLOW,

Kyoto Univ. (Japan); and Osaka Prefectural Technical Coll., Neyagawa (Japan). Katsumasa Yano, and Atsuyuki Daido. 13th Congr Int Assn Hydraul Res, Proc Vol 2, p 325-332, Aug-Sept 1969. 8 p, 6 fig, 4 ref.

Descriptors: *Bed load, *Velocity distribution, Laboratory tests, Open channel flow, Hydraulic laboratories, *Sediment load, *Streamflow, Shear stress, Sediments, Particles, Hydraulics, Rotational flow, *Movable bed models, Rotation, Hydrology, Reynolds number, Turbulent flow, Saltation. Identifiers: *Bedload movement.

The velocity distribution near the bed for bedloadladen flow deviates from the well-known logarithmic-velocity-distribution law. The deviation is caused by shear stress generated by the rota-tion of sediment particles. If liquid mass transport is caused by sediment rotation, a difference of momentum of the main flow direction generates between the upper and the lower layer of the rotation axis of the sediment particle. The difference of momentum is the stress component on an area element normal to the main flow axis. The shear stress caused by the sediment rotation must be added to Reynolds stress. Using the above hypotheses, a theory of velocity distribution was developed. Theoretical results showed that the velocity distribution for the bedload-laden flow holds a linear relation on the new semilogarithmic coordinates introduced to reflect the effect of shear stress caused by sediment rotation. Experimental results showed that the velocity in the regions affected and not affected by sediment are connected with one linear relation in the new semilogarithmic coordinates. The gradient of linear relation is derived. (USBR) W70-09052

PLANT COVER, RUNOFF, AND SEDIMENT YIELD RELATIONSHIPS ON MANCOS SHALE IN WESTERN COLORADO, Geological Survey, Denver, Colo. F. A. Branson, and J. B. Owen.

Group 2J—Erosion and Sedimentation

Water Resources Research, Vol 6, No 3, p 783-790, June 1970. 8 p, 6 fig, 1 tab, 18 ref.

Descriptors: *Soil-water-plant relationships, *Rainfall-runoff relationships, *Sediment yield, Geomorphology, Topography, Correlation analysis, Drainage patterns (Geologic), Drainage density, Runoff forecasting, Hydrograph analysis, Streamflow forecasting, Colorado.

Identifiers: Plant cover-runoff-sediment yield relations, Grand Junction (Colorado).

Relationships between vegetation and hydrologic measurements for 17 watersheds near Grand Junction, Colorado, were subjected to correlation analyses. Six years of vegetation measurements, four vegetation measurement methods, and 15 years of hydrologic records were used in the analyses. Highly significant correlation coefficients were found for percent bare soil and runoff, but the relationships between bare soil and sediment yields were not statistically significant. Geomorphic parameters such as angle of junction, mean slope, drainage density, relief ratio, length-width ratio, and watershed area were more highly correlated with sediment yields than with runoff. Correlation coefficients for spring vegetation measurements and runoff were higher than for autumn measurements. First contact methods and step point vegetation measurement methods were superior to the loop method and the all contacts point method. Curves for the relationship of runoff to bare soil were strikingly different for three sets of watersheds from different precipitation zones. Bare soil measurements may provide rapid and inexpensive estimates of runoff for watersheds similar to the ones studied. (Knapp-USGS) W70-09118

FLUME STUDIES OF THE SEDIMENT TRANSFER COEFFICIENT, Agricultural Research Service, Oxford, Miss. Sedi-

mentation Lab.

Neil L. Coleman.

Water Resources Research, Vol 6, No 3, p 801-809, June 1970. 9 p, 5 fig, 3 tab, 17 ref.

Descriptors: *Sediment transport, *Suspended load, *Suspension, *Hydraulic models, Flumes, Bed load, Open channel flow, Alluvial channels. Identifiers: Sediment transfer coefficient.

Flume experiments show that in open channel flow the sediment transfer coefficient increases with distance from the channel bed, reaching a maximum value at a distance from the bed equal to about 20% of the flow depth, and then tends to remain at a constant value up to the water surface. The experiments also yield evidence indicating that the sediment transfer coefficient is larger for larger particle sizes. (Knapp-USGS) W70-09119

EFFECTS OF RAINFALL ON SETTLING VELOCITY OF SUSPENDED SEDIMENT IN QUIESCENT WATER, Texas A and M Univ., College Station; and Florida

Univ., Gainesville.
S. I. Bhuiyan, E. A. Hiler, and E. T. Smerdon.
Water Resources Research, Vol 6, No 3, p 810-817, June 1970. 8 p, 7 fig, 1 tab, 12 ref. FWPCA Grant WP-00757-03.

Descriptors: *Settling velocity, *Clays, *Impact (Rainfall), Turbulence, Suspension, Suspended load, Sediment transport, Deposition (Sediments). Identifiers: Transmissometers.

Concentrations of kaolin and betonite clay suspen-Concentrations of kaolin and betonite clay suspensions with respect to time were determined in quiescent water by a transmissometer both with and without rainfall impinging on the surface. Rainfall caused significant increase in the settling velocity of sediments in quiescent water. The increase in the settling velocity was more for kaolin particles than for bentonite. Comparative results of the turbulant intensitive of the turbulant intensities of turbu the turbulent intensity at four depths caused by

rainfall on the quiescent water surface are presented (Knapp-USGS) W70-09120

A SYSTEM FOR MEASURING TOTAL SEDI-MENT YIELD FROM SMALL WATERSHEDS, Forest Service (USDA), Flagstaff, Ariz. Rocky Mountain Forest and Range Experiment Station. Harry E. Brown, Edward A. Hansen, and Norman E. Champagne, Jr.

Water Resources Research, Vol 6, No 3, p 818-826, June 1970. 9 p, 12 fig, 7 ref.

Descriptors: *Sampling, *Sediment load, *Sediment yield, Weirs, Dams, Instrumentation, Streamflow, Data collections, On-site data collections, Suspended load, Water analysis. Identifiers: Sample splitters, Sediment samplers.

Design and calibration data are presented from eight sediment measuring installations that have been constructed and tested by the U.S. Forest Service on the Beaver Creek pilot watershed in Arizona. Each installation includes a low dam and basin to trap coarse sediments and a series of splitters that collect a representative portion of the suspended sediment leaving the basin. The first splitter, a Barnes runoff sampler, is a sharp edged slot extending downstream from the dam spillway. With a 12-foot-wide spillway it extracts a theoretical split of 1/600 of the total volume of flow. The second splitter, an inclined slot mounted at the second spitter, an inclined stot mounted at the lower end of the Barnes sampler, extracts a theoretical 0.1 sample. This sample, 1/6000, enters an intermediate storage tank that leads from the middle of the stream channel to a final storage tank on the bank. The third splitter is a single slot, extracting 0.1 sample, mounted below a small rectandary in the action of the intermediate tank. gular weir in the end of the intermediate tank. The slot, which carries a 1/60,000 sample, enters the final storage tank. Calibration data are presented to characterize sampler performance, and a procedure is outlined for calculating total sediment yield. Errors in estimating total sediment are usually less than 18%. (Knapp-USGS)
W70-09121

STREAM ORDER AS A MEASURE OF SAMPLE SOURCE UNCERTAINTY, South Carolina Univ., Columbia.

W. E. Sharp.

Water Resources Research, Vol 6, No 3, p 919-926, June 1970. 8 p, 3 fig, 3 tab, 13 ref.

*Drainage patterns (Geologic), *Channel morphology, *Geomorphology, *Sampling, Statistical methods, Topography, Data collections, Statistics, Stochastic processes, Mar-kov processes, Probability, Path of pollutants. Identifiers: Stream order, Bifurcation ratio.

The Horton stream order at the outlet of a drainage basin is a direct measure of the uncertainty (enbasin is a direct measure of the uncertainty (entropy) of the source supplying any discrete particle or atom detected at the outlet. If m is the order of the main stream in a basin, the uncertainty that the source lies in the drainage area of an ith order tributary is given by m - i. This may be interpreted as representing the minimum number of tests or samples needed to find a single contamination source in a sequential server of a drainage hosis. source in a sequential search of a drainage basin.
Similarly Scheidegger's consistent stream order
may be interpreted as being the number of samples
required to search a basin for a single source when
the link magnitude of the outlet is known. Because natural streams usually have multiple contaminant sources and cannot be expressed as a single branching process, a convenient estimate of the average number of samples needed to find a single source is given by (r - 1) (m - i) where r is the bifurcation ratio. (Knapp-USGS) W70-09202

NEW YORK METROPOLITAN REGION--A MAJOR SEDIMENT SOURCE, State Univ. of New York, Stony Brook. Marine Sciences Research Center.

M. Grant Gross. Water Resources Research, Vol 6, No 3, p 927 931, June 1970. 5 p, 1 fig, 1 tab, 20 ref.

Descriptors: *Sediment yield, *New York, *Cities *Urbanization, *Waste disposal, Continental shelf Sludge disposal, Silts, Sands, Mud, Waste dumps: Solid wastes, Dredging.
Identifiers: New York Metropolitan Region.

Approximately 9.6 million tons per year of waster solids, including dredged sediment and constructors tion debris from the New York metropolitan region, was dumped in New York Bight and ininwestern Long Island Sound between 1964 and 1968. This was apparently the largest sediments source discharging directly into the North Atlantic Ocean (excluding the Gulf of Mexico) from the North American continent. Considering the core metropolitan region (population about 9 million) as the dominant source, the average annuals discharge was about I ton per person (equivalent) to about 6 pounds per person per day). (Knapp-USGS) W70-09203

CALIBRATION OF WALNUT GULCH SUPER-

CRITICAL FLUMES,
Agricultural Research Service, Stillwater, Okla. Soil and Water Conservation Research Div. For primary bibliographic entry see Field 02E.

VISUAL OBSERVATIONS OF SUSPENDED-PARTICLE DISTRIBUTION AT THREE SITES IN THE CARIBBEAN SEA,

Naval Oceanographic Office, Washington, D.C. Deep Vehicles Branch.

J. M. Costin.

Journal of Geophysical Research, Vol 75, No 21, p 4144-4150, July 20, 1970. 7 p, 4 fig, 11 ref.

Descriptors: *Suspended load, *Atlantic Ocean, Particle size, Turbidity, Sampling, Data collections, Submarines, Density, Stratification, Density stratification. Identifiers: Caribbean Sea.

Maxima and minima in concentrations of suspended particulate matter were observed from the manned submersible Deepstar-4000 at three dive sites in the western Caribbean area. Although depths of observed particulate maxima were different in each area, the layers of densest particle concentration were found between the 9 deg C and 12 deg C isotherms. This temperature level is generally coincident with the boundary between water of the Subtropical Undercurrent and Subantarctic Intermediate Water. It is believed that particle layers are a common feature of Caribbean stratification and result from low particle settling velocities, sediment erosion, and decreased vertical mixing at the depth of the thermal boundary. (K-napp-USGS)
W70-09231

DEPOSITION OF FINE-GRAINED SUSPENDED SEDIMENT FROM TIDAL CURRENTS, University of East Anglia, Norwich (England). School of Environmental Sciences. For primary bibliographic entry see Field 02L. W70-09232

A SUMMARY OF PRELIMINARY STUDIES OF SEDIMENTATION AND HYDROLOGY IN BOLINAS LAGOON, MARIN COUNTY, CALIFORNIA,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02L. W70-09235

AGE OF QUATERNARY SEDIMENTS AND SOILS IN THE SACRAMENTO AREA,

CALIFORNIA BY URANIUM AND ACTINIUM SERIES DATING OF VERTEBRATE FOSSILS, California Univ., Davis. Kearney Foundation of

Soil Science; and California Univ., Davis. Dept. of Soils and Plant Nutrition.

R. O. Hansen, and E. L. Begg. Earth and Planetary Science Letters, Vol 8, No 6, p 411-419, July 1970. 9 p, 3 fig, 2 tab, 19 ref.

Descriptors: *Radioactive dating, *Soils, *Sediments, *California, Uranium radioisotopes, Radioisotopes, Alluvium, Radioactivity techniques, Pleistocene epoch, Soil water movement,

Identifiers: Fossils, Vertebrate fossils.

Amethod of dating sediments and soils is proposed which utilizes a uranium and actinium series dating of buried vertebrate fossils. The method dates the Riverbank Formation east of Sacramento, California, and the overlying San Joaquin soil as 103,000 plus or minus 6,000 years. The age is in accordance with cited geological evidence. Chronological migrations of uranium, uranium-uptake and leaching are related to moisture conditions and hardpan formation. In absence of groundwaters, slower migrations of uranium in rain waters penetrating the soil profiles results in mean residence times of uranium within fossils to be less than the total elapsed time. Where groundwater has been present, absorption of uranium by fossils was rapid, the mean residence times of uranium are higher and equal to total elapsed time. U-234/U-238 ratios are lower in the wetter zones where water facilitates some remixing of uranium isotopes. Losses of uranium from some of the fossils are related to carbonate leaching. (Knapp-USGS) W70-09239

COMPUTATION OF THE DEFORMATION OF BARS AND NAVIGATION CHANNELS,

Akademiya Nauk Uzbekskoi SSR, Tashkent. Institut Matematiki.

stitut Matematiki.
Yu. T. Borshchevskiy, and A. A. Shakirov.
Translated from Bulletin of the Academy of Sciences of the Uzbek SSR, Technical Sciences Series (Izv. Akad, nauk UzbSSR, ser. tekh. nauk), No 2, p 52-55, 1969. Soviet Hydrology: Selected Papers, Issue No 2, p 192-195, 1969. 4 p, 6 ref.

Descriptors: *Sedimentary structures, *Channel morphology, *Sand waves, *Sand bars, Streamflow, Sediment transport, Sedimentation, Discharge (Water), Sediment discharge.
Identifiers: USSR.

A method is given for computing river bar deformations on the basis of the theory of motion of two-phase flows. It was established theoretically and confirmed by the results of field and model observations. Data required for computation are net sediment transport rate, sediment transport velocity, amplitude of channel bottom structures, water discharge, and channel width. (Knapp-USGS) W70-09256

WATER BALANCE AND SILTING OF SMALL RESERVOIRS IN THE CENTRAL CHERNOZEM OF THE RUSSIAN SOVIET FEDERAL SOCIALIST REPUBLIC.

Translated from Russian. US Agricultural Research Service, Washington, 1967. 403 p.

Descriptors: *Water balance, *Sedimentation, *Silting, *Reservoir silting, Lakes, Ponds, River basins, Infiltration, Mapping, Evaporation, Streamflow, Turbidity currents, Erosion, Bottom sediments, Evaluation, Chernozems.

Identifiers: *USSR, *Central Chernozem region.

This 12-paper collection summarizes some of the results of investigations carried out in 1956-1961-by the Laboratory of Limnology, Academy of Sciences, USSR, and studies by other organizations

of the regime of small rivers and reservoirs in the Central Chernozem Provinces. The paper by G. V. Lopatin gives information on the number, sizes and uses of reservoirs in the provinces and thoughts on further development of reservoirs on the national economy. Papers by I. P. Sukharev, A. M. Green and G. V. Nazarov, and by I. N. Sarokin discuss runoff characteristics of small drainage basins in the Central Chernozem Provinces. Water balance and hydrochemistry of small reservoirs are described in three papers. The papers by Ya. K. Kovalev, V. Ya. Frolov and L. V. Yakovlena relate to erosion, river sediment load and sediment accumulation. (See also W70-09313 thru W70-09315) (Lang-USGS) W70-09312

THE BALANCE METHOD OF COMPUTING SEDIMENT FLOW AND ESTIMATING THE RATE OF SILTING OF RESERVOIRS,

A. F. Kudryoshov.

Translated from Russian. In: Water Balance and Silting of Small Reservoirs in the Central Chernozem of the Russian Soviet Federal Socialist Republic, US Agricultural Research Service, p 374-403, 1967. 30 p, 4 fig, 5 tab, 25 ref.

Descriptors: *Silting, *Sedimentation rates, *Reservoirs, *Ponds, *Lakes, Sediment load, Mathematical studies, Estimating, Hydrologic properties, Discharge (Water), Suspended load, Rivers, Bottom sediments, Eddies, Agriculture, Gaging stations, Velocity, Particle size.

Identifiers: *USSR, Chernozem Provinces.

This study presents an analytical and experimental analysis of the application of the balance method for estimating reservoir silting using hydrogeological data recorded at a few reservoirs of the Mzymta River, USSR. The discussion includes: experience in the use of the balance method of estimating sediment flow; physical meaning of the Lakhtin number, and estimating the rate of reservoir silting. Several tables present the distribution of volumeweights of bottom sediments and the granulometric, specific gravity, and other pertinent characteristics of reservoir sediment flows. (See also W70-09312) (Gabriel-USGS) W70-09315

IN THE MORPHOLOGY OF GULLIES COLORADO ROCKY MOUNTAINS, Forest Service (USDA), Fort Collins, Colo. Rocky

Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 04D. W70-09372

INFLUENCE OF RAINFALL ENERGY ON SOIL LOSS AND INFILTRATION RATES: 2. effect of clod size distribution,

Agricultural Research Service, Ames, Iowa; and Iowa State University, Ames.
For primary bibliographic entry see Field 02G.
W70-09378

ISOPACHOUS MAPPING OF THE LOWER PATUXENT ESTUARY SEDIMENTS BY CONTINUOUS SEISMIC PROFILING TECHNIQUES, Naval Oceanographic Office, Washington, D.C. Coastal Oceanography Branch. For primary bibliographic entry see Field 02L. W70-09390

EFFECTS OF EFFLUENT AND INFLUENT SEEPAGE ON THE HYDRODYNAMIC FORCES ACTING ON AN IDEALIZED NONCOHESIVE SEDIMENT PARTICLE, Utah State Univ., Logan. Dept. of Civil Engineer-

For primary bibliographic entry see Field 08B. **W**70-09410

WATER EROSION, THE FORMING OF SEDI-MENT FLOW OF SMALL STREAMS IN THE

CENTRAL CHERNOZEM PROVINCES AND MEASURES FOR PROTECTING RESERVOIRS FROM SILTING,

V. Ya Frolov.

Translated from Russia. In: Water Balance and Silting of Small Reservoirs in the Central Chernozem of the Russian Soviet Federal Socialist Republic, U S Agricultural Research Service p 204-305, 1967. 102 p, 7 fig, 15 tab, 177 ref, 3 append.

Descriptors: *Erosion, *Erosion control, *Silting, *Sedimentation, *Sediment control, *Reservoirs, Reservoir silting, Lakes, Soil erosion, Agricultural watersheds, Runoff, Seasonal, Forests, Turbidity, Discharge (Water), Mathematical studies, Mapping, Rivers.

Identifiers: *USSR, Chernozem Provinces.

This is a comprehensive and detailed study of the erosion, sedimentation, and measures for erosion and siltation control of small reservoirs and streams of the Chernozem Provinces of the USSR. Soil erosion and the sediment flows of small streams in the Chernozem territory depends on many physical and geographic factors including relief, climate, soil, vegetarion, and others. The principal part of water and sediment flow of small streams is formed during the spring high-water period. Water erosion from fall-plowed land and from winter crops is about the same. The average rate of sediment flow of small streams is about 1.2 to 2.4 tons/hour. Comparison of accepted theoretical and experimental calculation of sediment runoff shows that the discrepancies between the computed and measured values were on the average greater than 50 to 100 percent. The use of empirical formulas for the longterm annual turbidities should considerably minimize these discrepancies. Reduction of inflow of sediment into a reservoir must take into consideration the administrative, economic, phytometeorative and hydrotechnical factors of the territory. (See also W70-09312). (Gabriel-USGS) W70-09414

TURBIDITY OF RIVERS AND ITS DISTRIBUTION IN THE CENTRAL CHERNOZEM TION IN TROVINCES,

Ya. K. Kovalev.

Translated from Russian. In: Water Balance and Silting of Small Reservoirs in the Central Cherof the Russian Soviet Federal Socialist Republic, collection of papers translated for U S Agricultural Research Service, p 187-203, 1967. 17 p, 4 fig, 1 tab, 10 ref.

Descriptors: *Turbidity, *Rivers, *Sediment yield, *Streamflow, Erosion, River basins, Mapping, Sediments, Suspended load, Forests, Seasonal, Snow, Topography, Geology, Floods, Precipitation (Atmospheric), Vegetation.
Identifiers: *USSR, Chernozem Provinces.

The average turbidity of rivers in the Central Cher-nozem Provinces, of the USSR were investigated and average long-term turbidity versus catchment area curves for four turbidity zones (20-50 g/cu m, 50-100 g/cu m, 100-200 g/cu m, and 200-500 g/cu m) were drawn. On the basis of these studies the map of the zones of average turbidity for the rivers of the Central Chernozem Provinces was con-structed. The turbidity determined from this map should provide better information for the distribution of erosion processes in the territory and for the design of erosion control measures. (See also W70-09312). (Gabriel-USGS)

CHARACTERISTICS OF SILTING OF SMALL RESERVOIRS OF THE CENTRAL CHER-NOZEM PROVINCES AND COMPUTATION OF DENSITY OF BOTTOM DEPOSITS,

L. V. Yakovleva.

Translated from Russian. In: Water Balance and Silting of Small Reservoirs in the Central Cher-Republic; collection of papers translated for U S Agricultural Research Service, p 306-329, 1967. 24 p, 4 fig, 5 tab, 19 ref.

Group 2J—Erosion and Sedimentation

Descriptors: *Reservoirs, *Lakes, *Ponds, *Silting, *Sedimentation, *Sedimentation rates, Mapping, Turbidity, Sediment transport, Erosion, River basins, Particle size, Organic matter, Mathematical studies, Sands, Silt, Clays, Sedimentary petrology. Identifiers: *USSR, Chernozem Provinces.

Silting of 44 small reservoirs in the Chernozem Provinces of the USSR was investigated analytically and experimentally by using the Lane-Koelzer formula, the Miller formula, and the Drozd-Myalkovskiy formula. A comparatively good agreement between values computed by Miller's formula and actual values was obtained for the ponds of up to 75 years of age, whereas the use of the Drozd-Myalkovsky formula resulted in errors up to 50% and more for old ponds. Large deviation from actual values was recorded by using the Miller and Drozd-Myalkovskiy formulas for a reservoir only 6 years old and for one 65 years old. (See also W70-09312). (Gabriel-USGS) W70-09417

DEVELOPING A METHOD OF COMPUTING SILTING OF SMALL RESERVOIRS IN THE CENTRAL CHERNOZEM PROVINCES,

Leningrad State Univ. (USSR). Limnology Lab. G. V. Lopatin.

Translated from Russian. In: Water Balance and Silting of Small Reservoirs in the Central Chernozem of the Russian Soviet Federal Socialist Republic, p 330-358, 1967. 29 p, 5 fig, 4 tab, 20

Descriptors: *Silting, *Sedimentation, *Reservoirs, *Ponds, *Lakes, *Mathematical studies, Erosion, Water supply, Discharge (Water), Sedimentation rates, Abrasion, Precipitable water, Industrial wastes streamflow, Turbidity, Statistical methods, Water loss. Identifiers: USSR, Chernozem Provinces.

After briefly discussing the causes inducing the precipitation of various substances in small reservoirs the author describes and analyzes the principal methods of computing silting in small reservoirs, the dependence of the trap efficiency of a reservoir on the degree of regulation of water flow and gives a few nomograms of silting whose construction is based on a few simple analytical expressions. The nomograms permit the computation of the value of the average annual loss of reservoir capacity for some period of time (T) by knowing the average annual turbidity of the water flow, the average volume-weight of the deposits, and the ratio of two indices, a and b. An example of using the nomograms is given. (See also W70-09312). (Gabriel-USGS) W70-09418

EROSION CONTROL ON ROADSIDES IN TEX-AS,

Texas Transportation Inst., College Station. Wayne G. McCully, and William J. Bowmer Available from NTIS as PB-191 353, \$3.00 in paper copy, \$0.65 in microfiche. Texas Transportation Institute Research Report 67-8 (final), July 69.

Descriptors: *Erosion control, Roadbanks, Vegetation establishment, Road construction, Planting management.

A progress report is made of a study recommending practices for vegetation establishment (seed mixtures, fertilizers, liming, soil preparation, planting dates and mulching) in various climatic and geographical regions in Texas. Tables indicating seed mixtures and planting dates for clay and sandy soil textures with a map designating geographical areas is included for reference. Illustrations, depicting methods, equipment operation and results of some experiments are included in the report. (BPR) W70-09451

2K. Chemical Processes

A STUDY OF THE HYDROCHEMICAL FACIES OF THE WILCOX AQUIFERS IN MISSISSIPPI, Mississippi State Univ., State College. Water

Resources Research Inst.

Donald M. Keady.

Available from NTIS as PB-193 685, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, July 1970. 42 p, 8 tab, 14 fig, 22 ref. OWRR Project A-038-MISS (1).

Descriptors: *Groundwater, *Dissolved solids, *Aquifer characteristics, *Chemical analysis, *Carbonates, Water quality, Iron, Mississippi, Aquifers, Geochemistry, Geologic formations, Calcium carbonate, Chlorides. Identifiers: *Facies, Hydrochemical facies, Wilcox

aquifers, Sodium carbonate.

The original concept of hydrochemical facies is modified using a simple linear model that is consistent with the definition of a facies. The model provides useful numerical parameters derived from the samples available. A set of 244 samples from the Wilcox and Meridian-Wilcox aquifers yielded eight significant hydrochemical facies containing 186 of the samples. The exclusion of the remaining samples indicates the sensitivity of the model. The eight facies are of the same general classes of water expected in sand aquifers in the coastal plain, but their characteristics are more closely defined. Maps showing the distribution of the facies reflect the geologic setting of the aquifers and the modification of the chemical quality of the water. From the outcrop down the dip the facies change from calcium-bicarbonate types to sodium-bicarbonate types to sodium-bicarbonate types. A large area of high quality sodium-bicarbonate water is present in the aquifers, especially in the Meridian-Wilcox. Other measures of water quality can be related to the hydrochemical facies in some cases, but many require separate study. Maps of the distribution of dissolved iron show several large areas where iron content is exceptionally high, especially in the Meridian-Wilcox aquifer. (Keady-Mississippi State) W70-09095

CHEMICAL COMPOSITION OF THE ICE OF OTKAZNENSKIY RESERVOIR,

Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR). I. M. Korenovskaya, and M. N. Tarasov.

1. M. Korenovskaya, and M. N. Tarasov. Translated from Hydrochemical Materials (Gidrokhimicheskiye Materialy), Vol 49, p 25-38, 1969. Soviet Hydrology: Selected Papers, Issue No 2, p 149-160, 1969. 12 p, 2 fig, 1 tab, 17 ref.

Descriptors: *Water chemistry, *Ice, *Freezing, *Reservoirs, *Iced lakes, Lake ice, Aqueous solutions, Limnology, Water quality, Solutes, Geochemistry

Identifiers: Reservoir ice, Ice chemical composi-

The chemistry was studied of ice formation in a reservoir in the USSR. The purposes of the investigation were to trace the change in the mineralization and chemical composition of the ice with time to determine the degree of vertical and horizontal distribution of the chemical characteristics of the ice cover of the reservoir, and to establish quantitatively how ice formation affects the increase in water mineralization during freeze-up. In the winter of 1967, the mineralization of the ice on Otakznenskiy Reservoir decreased gradually from 360 to 60 mg/liter by a factor of 6. Although the mineralization of the under-ice water was spatially uniform, ice composition differed in the vertical and horizontal directions. The mineralization of the upper ice layers was 3-10 times higher than that of the lower and differed at individual stations by a factor of 1.5-3.4. Despite the uneven mineralization of the ice, the average relative chemical composition remained practically constant with time and over the area. The ice formation process has a marked influence on the change in the mineralization of the water of the reservoir. Owing to this factor, water mineralization increased by 8% in the course of a month. (Knapp-USGS) W70-09097

HYDROCHEMICAL REGIME AND SALTI BALANCE OF OTKAZNENSKIY RESERVOIR IN THE FIRST YEAR OF ITS EXISTENCES (1966),

Nauchno Issledovatelskii Gidrokhimicheskii In-tstitut, Novocherkassk (USSR).

I. M. Pavelko, and M. N. Tarasov.

Translated from Hydrochemical (Gidrokhimicheskiye Materialy), Vol 49, p 48-54, 1969. Soviet Hydrology: Selected Papers, Issue No. 2, p 160-166, 1969. 7 p, 3 fig, 2 tab, 9 ref.

Descriptors: *Water chemistry, *Water balance, *Reservoirs, *Salt balance, Water quality, Arid lands, Evaporation, Leaching, Seepage.
Identifiers: USSR, Otkaznenskiy Reservoir, Kuma

The morphometry, water balance, and chemical balance in the first year of the Otkaznenskiy Reservoir, USSR, are described. Systematic investigations of the hydrochemical regime of the reservoir were begun in April 1966. The year-round hydrochemical investigations included monthly observations of the elements of the salt balance of the reservoir (the supply of salts from the atmosphere, river and groundwater, and also the loss of salts by water discharge into the lower pool, seepage through the dam body, etc.). Before the reservoir was filled in July 1965, a soil survey was made of its bed and water extracts were analyzed to establish soil salinity and its effect on the salt balance of the reservoir. Before the reservoir was built, the mineralization of the Kuma River fluctuated from 600 to 1700 mg/liter in the course of a year. The range of variations in the mineralization of the reservoir is less broad, 800-1500 mg/liter. The chemical composition of the river water was sulfatic over most of the year, except during summer floods, when the bicarbonate ion predominated in the anion composition. The Ca,
Na + K ions predominated in the cation composition. The chemical composition of the reservoir water is of sodium-sulfate type. The hydrochemical regime of the Kuma River changed from a Na-Ca-K sulfate to a predominantly Na-sulfate type as a result of its regulation by the Otkaznenskiy Reservoir in the first year of its existence. The salt balance of the reservoir shows as its main elements the supply of salts from river flow (88%) and the discharge of salts into the lower pool of the reservoir (70%). Such elements as the supply of salts from the reservoir bed (6.0%) and their removal with seepage water (20.7%) are also important in the first year of existence of a reservoir. (Knapp-USGS) W70-09098

OBSERVATIONS ON ACTIVITY AND DIFFUSION COEFFICIENTS IN NA-MONTMORIL-

Purdue Univ., Lafayette, Ind. Dept. of Agronomy. P. F. Low.

Research supported by a grant from the Div of Agr Development, Tennessee Valley Authority. Israel Journal of Chemistry, Vol 6, p 325-336, 1968. 12 p, 7 fig, 4 tab, 15 ref.

Descriptors: *Clay minerals, *Montmorillonite, *Ion transport, *Diffusion, Viscosity, Porosity, Water chemistry, Mineralogy, Clays.
Identifiers: Clay-water systems.

Double-layer theory was used to obtain the distribution of electrical potential between adjacent clay particles. From this distribution, the activity coefficients of the sodium and chloride ions in the system were calculated. The porosity of the clay-water system was calculated from the density and

Chemical Processes—Group 2K

concentration of clay, and the calculated value was used to calculate the geometry factor. This factor and the diffusion coefficient of water in bulkwater were used to calculate the diffusion that water would have in the clay if the water therein had its normal viscosity. The water in the clay was about twice as viscous as normal water. It was possible to compute the diffusion coefficients that Na and Cl would have in the absence of electrical interaction with the clay. To obtain closer agreement, electrical field strengths calculated by double-layer theory were used in an empirical equation relating viscosity and field strength to obtain the distribution of viscosity relative to the particle surfaces. Also, double-layer theory was used to obtain ionic distributions with respect to these surfaces. From the resulting distributions it was possible to determine, the ionic diffusion coefficients that should obtain in the clay system. (Knapp-USGS) W70-09105

HYDROCARBONS IN THERMAL AREAS, NORTHWESTERN WYOMING, Geological Survey, Washington, D.C., and National Park Service, Washington, D.C. J. D. Love, and John M. Good.

For sale by Superintendent of Documents, U S Government Printing Office, Wash, D C 20302 - Price \$0.40 (paper cover). U S Geological Survey Professional Paper 644-B, P B1-B23, 1970. 23 p, 15 fig, 1 tab, 36 ref.

Descriptors: *Thermal springs, *Distillation, *Oily water, *Wyoming, Hot springs, Thermal water, Steam, Organic matter, Sedimentary rocks, Bituminous materials.

Identifiers: Hydrocarbons, Yellowstone National

Five natural occurrences of hydrocarbons in thermal areas lie in an arcuate southeastward-to eastward-trending area 70 miles long in northwestern Wyoming. The westernmost three are in Yellowstone National Park. All are associated with abundant sulfur and thermal springs and vents. Four are surrounded and underlain by volcanic rocks, which range in age from Eocene to Pleistocene. The fifth emerges from Paleozoic strata. The source of the hydrocarbons could be Paleozoic or Mesozoic sedimentary rocks that underlie the surficial volcanics, but at Rainbow Springs the oil might have been distilled from Pleistocene nonmarine algae at shallow depth. Sulfur isotope analyses do not indicate conclusively whether the sulfur is of igneous or bacteriogenic origin. In at least two of the localities, hot water and steam that derive their heat from an igneous source below the sediments are believed to relate directly to the extraction of the hydrocarbons, transport upward along conduits, and extrusion on the surface. (Knapp-USGS)
W70-09108

ELEMENTAL SULFUR IN EDDY COUNTY, NEW MEXICO,

MEW MEXICO,
Geological Survey, Washington, D.C.
Jim S. Hinds, and Richard R. Cunningham.
Available free on application to the US Geological
Survey, Wash, DC, 20242. US Geological Survey
Circular 628, 1970. 13 p, 4 fig, 10 ref.

Descriptors: *Sulfur, *New Mexico, *Water chemistry, Reduction (Chemical), Hydrogen sulfide, Sulfates, Gypsum, Water circulation, Groundwater, Chemical reactions, Carbonate rocks, Groundwater movement.
Identifiers: Eddy County (N. Mex).

Sulfur has been reported in Eddy County, N. Mex., in rocks ranging from Silurian to Holocene in age at depths of 0-15,020 feet. Most of the reported sulfur occurrences are in the Abo, Yeso, and San Andres Formations and the Artesia Group. Sulfur deposition in the dense dolomites of the Abo, Yeso, and San Andres Formations is attributed to the reduction of ionic sulfate by hydrogen sulfide in forma-tion waters in zones of preexisting porosity and

permeability. A similar origin accounts for most of the sulfur deposits in the formations of the Artesia Group, but some of the sulfur in these formations may have originated in place through the alteration anhydrite to carbonate and sulfur by the metabolic processes of bacteria in the presence of hydrocarbons. Sulfur deposits in the Castile Formation are found in irregular masses of cavernous brecciated secondary carbonated rock enveloped by impermeable anhydrite. Formation of carbonate rock and sulfur in the castiles is attributed to the reduction of brecciated anhydrite by bacteria and hydrocarbons in the same process ascribed to the formation of carbonate and sulfur in the caprocks of salt domes. (Knapp-USGS) W70-09128

CHEMICAL COMPOSITION OF PRECIPITA-TION IN REGIONS OF THE SOVIET UNION, Main Geophysical Observatory, Lenings

Leningrad (USSR).

For primary bibliographic entry see Field 02B. W70-09133

CHEMICAL HYDROLOGY OF REGIONS OF EAST ANTARCTICA, Nauchno Issledovatelskii Gidrokhimicheskii In-

stitut, Novocherkassk (USSR). A. A. Matveev.

Journal of Geophysical Research, Vol 75, No 18, p 3686-3690, June 20, 1970. 5 p, 4 tab, 4 ref.

Descriptors: *Chemistry of precipitation, *Antarctic, Ice, Snow, Sampling, Data collections, Water chemistry, Precipitation (Atmospheric), Runoff,

Identifiers: USSR.

Samples of atmospheric precipitation, snow, and ice were collected during the IGY in East Antarctica. The chemical composition of the precipitation and of the snow and ice cover is influenced by the relief and climatic features of the antarctic continent. Three distinctive zones can be identified in East Antarctica: the coastal strip, the oasis, and the inland region. The main feature of the chemical hydrology of the coastal strip is its comparatively high concentration of substances in precipitation, which ranged from 3.3 to 260.8 mg/l. The composition of atmospheric precipitation in this zone is influenced by the ocean. The relation of changes in the concentration of precipitation constituents to the dynamics of air masses over the region of observation, as well as to position of the drifting ice edge, was investigated. Precipitation in the ice-free surface area of the Antarctic oasis region is characterized by a predominance of HCO3, Na, K, and CA ions. Fluctuations in the snow mineralization are 1 to 4 mg/l in this zone. Snow differs from that of the coastal strip by variations in ion concentrations. Calculation of the chemical ice runoff showed some excess in the accumulation of salts by precipitation over runoff. (Knapp-USGS) W70-09134

COMPOSITION OF WATER IN CLINCH RIVER, TENNESSEE RIVER, AND WHITEOAK CREEK AS RELATED TO DISPOSAL OF LOW LEVEL RADIOACTIVE LIQUID WASTES, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 05B. W70-09194

EXPERIMENTS ON THE ADSORPTION OF AMMONIUM IONS BY CLAY PARTICLES IN NATURAL WATERS,

Oklahoma State Univ., Stillwater. Reservoir Research Center.

Dale W. Toetz. Water Resources Research, Vol 6, No 3, p 979-980, June 1970. 2 p, 1 tab, 4 ref. Project A-001-

Descriptors: *Adsorption, *Clay minerals, *Ion exchange, Ions, Turbidity, Geochemistry, Water

chemistry, Water quality, Suspended load, Labora-

Identifiers: Clay-solute interactions.

The situation where the counter ion NH4 on particulate matter establishes a dynamic equilibrium with other cations in surface waters was simulated experimentally by mixing a powdered subsoil and a montmorillonite, respectively, with diluted well water. Adsorption was demonstrated in one case, but the employed technique lacked the sensitivity needed to measure adsorption of NH4 at concentrations normally encountered in freshwater. (K-napp-USGS) W70-09211

A MODIFICATION OF THE BENZENE SYNTHESIS METHOD FOR TRITIUM ANALY-SIS,

Florida State Univ., Tallahassee. Edward I. Wallick, and George A. Knauer. Water Resources Research, Vol 6, No 3, p 986-988, June 1970. 3 p, 1 fig, 2 tab, 4 ref.

Descriptors: *Tritium, *Water analysis, Analytical techniques, Laboratory tests, Radioisotopes, Chemical analysis.

Identifiers: Benzene synthesis.

A modification of the benzene synthesis method for tritium analysis by liquid scintillation counting is suitable for limited production of hydrologic samples. Procedures are described for elimination of sulfide quenching of the benzene and optimization of the acetylene-benzene conversion. Tritium isotopic fractionation is constant during benzene synthesis with a loss of (19.3 plus or minus 0.2)% of the water sample tritium activity. Cross checks with other laboratories agree within counting statistical error. (Knapp-USGS)
W70-09213

CHEMICAL CHARACTERISTICS OF WATER MASSES IN THE AMERASIAN BASIN OF THE

Alaska Univ., College. Inst. of Marine Science. Patrick Kinney, Martin E. Arhelger, and David C.

Journal of Geophysical Research, Vol 75, No 21, p 4097-4104, July 20, 1970. 8 p, 12 fig, 20 ref. ONR Contract N000 14-67-A-3017-0001.

Descriptors: *Water chemistry, *Arctic ocean, *Ocean circulation, Water temperature, Salinity, Dissolved oxygen, Nutrients, Density, Density stratification, Thermal stratification, Mixing, Advection, Oxidation, Ocean currents, Oceanog-

Identifiers: Amerasian basin.

Detailed vertical profiles of hydrographic data and routine chemical parameters (oxygen, nutrients) were taken in the Amerasian basin of the Arctic Ocean and in the Bering Strait and Chukchi Sea. Correlations of these chemical profiles with water mass sources and mixing processes are postulated. The water of the sharp temperature maximum at about 75-meter depth is chemically a mixture of the arctic surface water and core water from about 160 meters. This core water corresponds to the temperature minimum and nutrient maximum and is of Bering Strait-Chukchi Sea origin. The temperature maximum and minimum simply reflect differing thermal regims existing in the Chukchi. Extremely close vertical sampling has shown in-triguing detail in the oxygen, temperature, salinity, and nutrient profiles in the area of the very sharp oxygen minimum occurring at about 205 meters. Temperature-salinity and chemical plots of the close-interval data identify a core of water at approximately 230 meters that is mixing above with Bering core water at 160 meters and below with the Atlantic core water at about 500 meters. Thus the oxygen minimum appears to be at least partly due to advection of shelf water into the basin rather than to in situ oxidation alone. (Knapp-USGS)

Group 2K—Chemical Processes

LEAD IN A SUBURBAN ENVIRONMENT,

P. R. Atkins.

Journal Air Pollution Control Association, Vol 19, No 8, p 591-594, August 1969. 4 p, 14 ref.

Descriptors: *Air pollution, *Heavy metals, *Fallout, *Urbanization, Highway effects, Raindrops, Nucleation, Sediments, Particle size.

Identifiers: *Lead fallout, Highway traffic, Pollu-

The lead content of air, rainfall, and dry fallout samples taken at several sites in Palo Alto, California are reported and discussed. Major source of lead pollution apparently is the high-speed, high-density freeway traffic in the area. The natural atmospheric cleansing processes of sedimentation and raindrop scavenging remove large quantities of lead particulate matter. Nucleation probably occurs on the submicronic lead compound particles in exhaust streams, making droplets which impact on the larger airborne particles. This could explain the wide size distributions range reported in the literature as well as the large amounts of lead found in the samples analyzed. (Lang-USGS) W70-09251

EFFECTS OF SALTS AND ORGANIC MATERIALS ON THE HYDRAULIC CONDUCTIVITY OF THE SOILS,

National Taiwan Univ., Taipei. Dept. of Agricultural Chemistry

For primary bibliographic entry see Field 02G. W70-09290

DISSOLVED SOLIDS-DISCHARGE RELATION-SHIPS: 1. MIXING MODELS,

New Hampshire Univ., Durham

Francis R. Hall.

Water Resources Research, Vol 6, No 3, p 845-850, June 1970. 6 p, 1 fig, 7 ref. OWRR A-002 NH.

Descriptors: *Water quality, *Streamflow, *Dissolved solids, *Mathematical models, Aqueous solutions, Solutes, Mixing, Leaching, Dispersion, Diffusion, Discharge (Water)

Identifiers: Discharge-dissolved solids relationships, Mixing models.

A reasonable basis is needed for the selection of models to aid in analyzing the relationships between dissolved constituents and discharge in streams. A series of simple mixing models based on mass balance calculations is presented along with derivations and solutions for assumptions about the mixing volumes and the storage volume-discharge relationship. If concentration and discharge data show a hysteresis or loop relationship with time, then the commonly assumed direct relationship between total volume of water in the stream channet and stream discharge is probably not valid. The relationship of the constants in the derived equations to physical or chemical factors is masked at the present time by the nature of the initial assumptions and the method of derivation. (Knapp-USGS) W70-09311

A GEOCHEMICAL DRAINAGE SURVEY IN CENTRAL ECUADOR,

Kennecott Exploration del Ecuador, Quito; and

Proyecto Minero, Quito (Ecuador).
Tjepke P. Kroon, and Ann de Grys.
Economic Geology, Vol 65, No 5, p 557-563, August 1970. 7 p, 3 fig, 3 ref.

Descriptors: *Surveys, *Geochemistry, *Exploration, *Trace elements, Water chemistry, Surface waters, Runoff, Streamflow, Leaching, Sediments, Mineralogy, Solutes, Sampling. Identifiers: Ecuador.

A reconnaissance drainage sediment survey was carried out over 10,000 sq km in the Cordilleras of Central Ecuador. Long dispersion trains of zinc extend over several kilometers and are associated with shorter trains of Pb, As, Ag, Sb and Bi. These metals are derived from epithermal deposits containing galena, sphalerite, arsenopyrite and Ag-Sb-Bi sulfides. Very pronounced copper-molybdenum anomalies could be traced over long distances in streams of a major drainage basin. The anomalies were derived from the copper-molybdenum porphyry occurrence at Chaucha. Copper-zinc anomalies of moderate length derive from the oxidation of disseminated pyrite in andesitic volcanics. Zinc anomalies extend for 1-2 km in streams originating in the poorly drained highlands, or 'paramo.' Polymetallic anomalies of Cu, Zn, Mo, V, Ni, Co, and As are found in streams draining an area of black shales. (Knapp-USGS) W70-09352

WATER TECHNOLOGY, Rice (Cyrus Wm.) and Co., Pittsburgh, Pa. For primary bibliographic entry see Field 03A. W70-09361

HYDROCHEMICAL CHARACTERISTICS OF SMALL RESERVOIRS IN SOME DISTRICTS OF THE CENTRAL CHERNOZEM PROVINCES, I. Ya. Degopik.

Translated from Russian. In: Water Balance and Silting of Small Reservoirs in the Central Chernozem of the Russian Soviet Federal Socialist Republic, p 166-186, 1967. 21 p, 3 fig, 3 tab, 17

Descriptors: *Hydrologic aspects, *Hydrologic data, Chemical properties, *Reservoirs, *Ponds, Chernozems, Limnology, Silting, Reservoir silting, Rivers, Forests, Geology, Runoff, Seasonal, Gases, Carbon dioxide, Vegetation, Water chemistry, Bicarbonates, Chemical analysis. Identifiers: *USSR, Chernozem Provinces.

Hydrochemical characteristics of the small ponds and reservoirs of Kursk Province, USSR were recorded and analyzed during 1956-1960. In general, the content of dissolved gases in the pond waters is subject to large variations, and the waters in the first years of their existence are characterized by absorption of dissolved oxygen and by a simultaneous increase in the content of carbon dioxide. The extreme values of mineralization are 62 and 646 mg/liter with the greatest number of inozand o40 mig/ner with the greatest number of in-vestigated ponds having a narrow range of mineralization (150 to 250 mg/liter). The mineralization of ponds fed by groundwater does not reach high values and, on the average, does not exceed 400 mg/liter. (See also W70-09312). (Gabriel-USGS)

NITRATE VARIATION IN GROUNDWATER,

Wisconsin Univ., Madison. Water Resources

For primary bibliographic entry see Field 05A. W70-09425

2L. Estuaries

TWO LAYER MODEL OF STRATIFIED FLOW IN AN ESTUARY, Waterloopkundig Laboratorium, Delft (Nether-

lands). C. B. Vreugdenhil. La Houille Blanche, No. 1, 1970, p35-40, 9 fig, 3

Descriptors: *Density stratification, *Mathematical model, Saline water, Freshwater interfaces, Numerical analysis, Estuarines, Tidal effects, Velocity, Continuity equation, Water waves. Identifiers: Rotterdam waterways, Boundary conditions, Interfacial facility. tions, Interfacial friction.

A mathematical model was developed and compu-A mathematical model was developed and computations were verified by means of prototype data from the Rotterdam Waterway of 1956. The data for computation included case A (with tidal computation) and case B (without tidal computation). By comparison of case A and case B, it was con cluded that the horizontal tide is the main factor in fluencing the salt wedge. It was noticed that the vertical tide was 2 hours late in case B. A secon important factor is the seaward boundary condition for the internal flow and the essential processes c supercritical in and outflow should be included The evaluation of the correspondence betwee measurements and computations depends on the required accuracy. Results showed a reasonable reproduction of the layer-thickness and velocities The method is considered to be useful for man practical purposes. Essentially, the value of the two-layer model is determined by the empirical parameter k (coefficient of interfacial friction which can be estimated depending on the overala conditions of the estuary. (Hsieh-Vanderbilt)

RESEARCH NEEDS ON THERMAL AND SEDI-IMENTARY POLLUTION IN TIDAL WATERS.

American Society of Civil Engineers. Committee on Tidal Hydraulics of the Hydraulics Div. For primary bibliographic entry see Field 05B. W70-09161

ESTUARY ENTRANCE, UMPQUA RIVER, I OREGON; HYDRAULIC MODEL INVESTIGA-. TION,

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

G. M. Fisackerly.
Sponsored by U.S. Army Engineer District, Portland. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report H-70-6, May 1970. 20 p, 3 tab, 83 photo, 177 pl.

Descriptors: *Estuaries, *Hydraulic models, Shoals, Channel improvement, Jetties, Currents (Water), Oregon.
Identifiers: *Umpqua River, Navigation conditions.

Model was of fixed-bed type, constructed to scales of 1:300 horizontally and 1:100 vertically, reproducing the lower 28 miles of Umpqua River and an adjoining portion of the Pacific Ocean. Purpose of model study was to determine optimum plan for the reduction of shoaling and elimination of crosscurrents in the navigation channel at the entrance. Model verification tests indicated that the model hydraulic and salinity regimens were in satisfactory agreement with those of the prototype for comparable conditions, and therefore model provided quantitative answers concerning the efprovided quantitative answers concerning the effects of the proposed plans on the hydraulic and salinity regimens of the estuary. Optimum plan consisted of existing conditions plus a 2600-ft extension of the training jetty to the outer end of the south jetty. Results of model tests indicate that the optimum plan eliminated the crosscurrents without aggravating the wave climate or shouling condiaggravating the wave climate or shoaling conditions. (Spivey-Waterways Experiment Station) W70-09179

A NUMERICAL TECHNIQUE FOR CALCULATING THE TRANSIENT POSITION OF THE

Geological Survey, Washington, D.C.
George F. Pinder, and Hilton H. Cooper, Jr.
Water Resources Research, Vol 6, No 3, p 875-882, June 1970. 8 p, 5 fig, 14 ref.

Descriptors: *Saline water intrusion, *Aquifers, *Mathematical models, *Numerical analysis, Groundwater movement, Saline water-freshwater interfaces, Unsteady flow, Mixing, Diffusion, Permeability, Viscosity.

Identifiers: Saltwater front (Aquifers).

The movement of the saltwater front in coastal aquifers, including the effect of dispersion, can be determined by using numerical methods. The method of characteristics is used to solve the solute transport equation, and the alternating direction iterative procedure is used to solve the ground-water flow equation for the two-dimensional

Estuaries—Group 2L

roblem. This approach permits the treatment of ransient flow in nonhomogeneous aquifers with iregular geometry. (Knapp-USGS) V70-09196

OME EFFECTS OF FRESH-WATER INFLOW ON THE FLUSHING OF SOUTH SAN FRAN-CISCO BAY: A PRELIMINARY REPORT, Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 05G.

MOVEMENT OF SEABED DRIFTERS IN THE SAN FRANCISCO BAY ESTUARY AND THE ADJACENT PACIFIC OCEAN: A PRELIMINA-RY REPORT,

Geological Survey, Washington, D.C.

T. J. Conomos, D. H. Peterson, P. R. Carlson, and

D. S. McCulloch.

Available free on application to the U S Geological Survey, Washington, DC 20242. In: A Preliminary Study of the Effects of Water Circulation in the San Francisco Bay Estuary, U S Geological Survey Circular 637-B, p B1-B8, 1970. 4 fig, 2 tab, append.

Descriptors: *Estuaries, *Bays, *Water circulation, *Currents (Water), *California, Aquatic drift, Tides, Current meters, Drift bottles, Drifting (Aquatic).

Identifiers: *San Francisco Bay.

The movement of near-bottom water is of considerable importance in transporting suspended materials between the Pacific Ocean and the San Francisco Bay system. Owing primarily to tidal flow, the movement of near-bottom water may be oscillatory. There is, however, a residual drift. To describe this residual drift, the U. S. Geological Survey is releasing seabed drifters bimonthly within the San Francisco Bay system and on the continental shelf of central California from Cape Mendocino to Point Conception. From southern San Pablo Bay to northern San Francisco Bay, dominant movement was to the north and west, with maximum transport distances of 40 km. In south San Francisco Bay, little apparent net movement and no prevalent direction was measured. (Knapp-USGS) W70-09216

DISPERSION IN HOMOGENEOUS ESTUARY

Illinois Univ., Urbana; Massachusetts Inst. of Tech. Cambridge; and California Univ., Berkeley. Dept.

of Civil Engineering. Edward R. Holley, Donald R. F. Harleman, and Hugo B. Fischer.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY8, Paper 7488, p 1691-1709, August 1970. 9 p, 6 fig, 1 tab, 33 ref, append. NSF Grant GK-3210.

Descriptors: *Dispersion, *Estuaries, *Path of pollutants, *Mathematical models, Velocity, Diffusion, Tidal effects, Currents (Water), Turbulence, Turbulent flow.

Identifiers: Estuary flow.

The effects of the transverse variations of velocity on dispersion in oscillatory estuary flow were investigated. The dispersion coefficient is found to depend on the tidal period and a characteristic time for turbulent diffusion. Applying the relationship to some estuaries, it is concluded that the effects of the transverse variations of velocity may cause dispersion to be as much as 10 times greater than it would be if only the vertical variations were considered. However, for continuous injection conditions, this possible increase appears to cause calculated concentrations to change by only 10% to 15%. (Knapp-USGS)
W70-09217

DEPOSITION OF FINE-GRAINED SUSPENDED SEDIMENT FROM TIDAL CURRENTS,

University of East Anglia, Norwich (England). School of Environmental Sciences. I. N. McCave.

Journal of Geophysical Research, Vol 75, No 21, p 4151-4159, July 20, 1970. 9 p, 3 fig, 2 tab, 28 ref.

Descriptors: *Sedimentation, *Tidal waters, *Tidal effects, *Currents (Water), *Deposition (Sediments), Marine geology, Tides, Sedimentary structures, Sedimentation rates, Sediment transport. Identifiers: Tidal currents.

Reliance on the commonly expressed assumption that fine-grained sediment is deposited from tidal systems only at slack tide is found to give rates of deposition much lower than those actually found in the German Bight. A model of quasi-continuous deposition is formulated with the assumption that the viscous sublayer of the turbulent boundary layer accepts sediment by settling but does not eject it back into the main flow. This model is only valid at low shear values (less than 1.2 cm/sec). Recent studies of the nature of the viscous sublayer have shown that it is periodically disrupted with fluid ejection as the result. There is a slight excess of ejection over input for sediment, and rates of deposition by the quasi-continuous model will be somewhat too high. Application of these models to mud layers in tidal deposited sands and in flaser bedding shows that these layers cannot be produced during slack tide. The time is too short and suspended sediment concentrations are too low. These layers must represent some periodicity other than that of tides, possibly that of storm and calm conditions. (Knapp-USGS)

A SUMMARY OF PRELIMINARY STUDIES OF SEDIMENTATION AND HYDROLOGY IN BOLINAS LAGOON, MARIN COUNTY, CALIFORNIA,

Geological Survey, Washington, D.C.

US Geological Survey Circular 627, 1970. 22 p, 5 fig, 1 tab, 19 ref.

Descriptors: *Sedimentation, *Sediment transport, *Bays, *Lagoons, *California, Currents (Water), Sediment transport, Littoral drift, Water circulation, Particle size, Sands, Provenance. Identifiers: Bolinas Lagoon (Calif).

The U.S. Geological Survey is investigating sedimentary and hydrologic conditions in Bolinas Lagoon, a 1,100-acre lagoon 15 miles northwest of San Francisco. Two series of measurements of suspended-sediment load and water discharge in Bolinas Lagoon inlet showed that much of the suspended sediment is sand and that the average velocity was as much as 4.7 feet per second. Littoral drift near the inlet was generally toward the inlet, whereas farther from the inlet the pattern is irregular. Circulation velocities in the lagoon decrease rapidly away from the inlet, but probably remain high enough to erode bottom sediment along the channels. In most of the lagoon median size of bottom sediment was fine sand, Sediment was derived chiefly from Monterey Shale. (Knapp-USGS) W70-09235

COASTAL WETLANDS OF VIRGINIA-IN-TERIM REPORT, Virginia Inst of Marine Science, Gloucester Point.

Marvin L. Wass, and Thomas D. Wright. Virginia Institute of Marine Science Special Report in Applied Marine Science and Ocean Engineering No 10, December 1969. 154 p, 19 fig, 6 tab, 81 ref, append.

Descriptors: *Wetlands, *Virginia, *Surveys, *Land management, *Conservation, Wildlife conservation, Water law, Zoning, Legislation, Economics, Land resources, Fishing, Natural resources, Preservation, Scenery, Recreation. Identifiers: Virginia coastal wetlands.

Coastal wetlands occupy only 1% of the total area of Virginia, and marshes occupy 1/2%. Yet 95% of Virginia's annual harvest of fish (commercial and sport) from tidal waters is dependent to some degree on wetlands. Wetland productivity ranges from very little on some small salt barrens to about 10 tons per acre per year in the best grass marshes. Productivity on the tidal flats, which apparently cover more area than does marsh on the Eastern Shore seaside is probably at least one-fourth that in the marsh. Virginia has not adopted a legal definition of wetlands. Such a definition is needed before protective legislation can be enacted. Preliminary economic evaluation of wetland productivity indicates that an average acre of wetland generates primary tangible benefits of \$78/year. These benefits largely accrue to the public rather than to the wetland owner. Present wetland use and management is determined by the owner and often does not constitute the most beneficial use of the land to the public. To insure continuing high yields, to enhance value, and to serve the best public interests, it is recommended that the State acquire or otherwise exercise some degree of control over the uses and alterations of wetlands. (Knapp-USGS) W70-09350

POLLUTION OF ESTUARIES,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 05C. W70-09383

ISOPACHOUS MAPPING OF THE LOWER PATUXENT ESTUARY SEDIMENTS BY CONTINUOUS SEISMIC PROFILING TECHNIQUES, Naval Oceanographic Office, Washington, D.C.

Coastal Oceanography Branch. Newell T. Stiles, and Donald R. Wiesnet.

U S Naval Oceanographic Office Informal Report No IR 70-37, May 1970. 26 p, 11 fig, 1 tab, 21 ref.

Descriptors: *Profiles, *Bottom sediments, *Estuaries, *Sounding, Instrumentation, Mud, Sediments, Sedimentation, Channel morphology, Acoustics, Bathymetry, Surveys. Identifiers: Patuxent Estuary.

The thickness and extent of the sediment cover in the Patuxent Estuary was determined using a highfrequency, high-spatial resolution, shallow-penetration, continuous seismic profiling system. The isopachous map provides the sub-bottom information required to determine optimum locations for placing test equipment on the river bottom. Mud filled depressions, acoustically transparent to 12-kHz sound pulses, occur mainly north of Half Pone Point, and east of the present river channel. Based on identification of first sub-bottom reflectors, these depressions are as much as 16 feet thick. The dominance of the thicker deposits east of the channel and evidence of a submerged terrace indicates that either the channel has migrated to the west, or that the channel of the Patuxent River at this location was larger in the past and has subsequently filled in much of the material on the eastern edge. Maximum penetration at the scarp of the submerged terrace was 36 feet beneath the water-sediment interface. (Knapp-USGS)

THE EFFECT OF SALINITY ON THE OXIDA-TION OF HYDROCARBONS IN ESTUARINE ENVIRONMENTS,
Mississippi State Univ., State College. Water

Resources Research Inst.

For primary bibliographic entry see Field 05B. W70-09424

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

03. WATER SUPPLY **AUGMENTATION** AND CONSERVATION

3A. Saline Water Conversion

DISPOSAL OF BRINE BY SOLAR EVAPORA-TION: FIELD EXPERIMENTS,

New Mexico State Univ., University Park For primary bibliographic entry see Field 02D. W70-09150

COST CALCULATING DESALTING PROCEDURES.

Southwest Research Inst., Houston, Tex.
W. L. Prehn, Jr., and J. L. McGaugh.
For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price \$1.25. US Office of Saline Water Research and Development Progress Report No 555, May 1970. 143 p, 50 fig, 2 tab, 74 ref, 8 ap-

Descriptors: *Desalination plants, *Cost analysis, Cost comparisons, Construction costs, Maintenance costs, Operating costs, Water costs, Total costs, Water rates, Waste water disposal, Injection wells, Evaporation pans.

Identifiers: Desalination costs.

This report presents the results of a study and com-pilation of desalting cost calculating procedures by alternative desalting methods and related systems. The user may calculate, for cost comparison purposes, the capital costs and operating and maintenance costs for five desalting processes as a preliminary to a possible detailed engineering feasi-bility analysis. The five desalting processes are: (1) electrodialysis (ED), (2) reverse osmosis (RO), (3) multistage flash distillation (MSF), (4) vapor compression-vertical tube evaporator-multistage flash distillation (VC-VTE-MSF), and (5) vacuum-freezing vapor-compression (VFVC). (Knapp-USGS) W70-09241

MANUAL ON SOLAR DISTILLATION OF SALINE WATER,
Battelle Memorial Inst., Columbus, Ohio.
S. G. Talbert, J. A. Eibling, and G. O. G. Lof.
For sale by the Superintendent of Documents, US
Government Printing Office, Washington, DC
20402 - Price \$2.00. US Office of Saline Water
Research and Development Progress Report No
546, Apr 1970. 263 p, 152 fig, 23 tab, 529 ref.
OSW Contract No 14-01-0001-1695.

Descriptors: *Solar distillation, *Desalination processes, *Distillation, *Desalination apparatus, *Solar stills, Dropwise condensation, Heat transfer, Solar radiation, Evaporation, Water supply, Water costs, Saline water, Economics. Identifiers: Solar desalination.

This manual, prepared under the sponsorship of the U.S. Office of Saline Water, is a comprehensive treatise on the state of the art of solar distillation. Its primary purposes are to apprise water-supply planners of the potential of solar distillation and to assist them in designing practical plants. Information for the manual was assembled from an extensive review of the literature and from correspondence and discusses with calculative desires. dence and discussions with solar-still designers from various countries. An attempt was made to classify the various designs into recognizable categories in which there are realistic data and to present the kind of information that will assist present the kind of information that will assist solar-still designers in making logical choices of design features for their particular situations. Solar distillation of salt water appears well suited to the supply of potable water to small communities where the natural supply of fresh water is inadequate or of poor quality, and where sunshine is reasonably abundant. The distilled water cost is between \$3 and \$4 per 1000 gallons. These water costs are generally lower than those associated with perhaps 50,000 gpd. (See also W70-09243) (K-napp-USGS)
W70-09244

FINAL REPORT ON REVERSE OSMOSIS MEMBRANES CONTAINING GRAPHITIC OX-

IDE, Westinghouse Electric Corp., Pittsburgh, Pa. E. S. Bober, L. C. Flowers, P. K. Lee, and D. E. Sestrich.

For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. US Office of Saline Water Research and Development Progress Report No 544, May 1970. 116 p, 15 fig, 24 tab, 53 ref. OSW Contract No 14-01-0001-2154.

Descriptors: *Membranes, *Reverse osmosis, *Clay minerals, Semipermeable membranes, Permselective membranes, Laboratory tests, Bentonite, Membrane processes

Identifiers: Graphitic oxide membranes.

Membranes formed from graphitic oxide (GO) and from bentonite clay were tested for reverse osmosis performance. GO membranes fabricated from a three year old batch of GO had essentially the same performance as those formed a year and a half earlier indicating that aging of the dispersions is not a problem. The mechanical strength of GO membranes was significantly improved by overcoating them with a layer of microcrystalline collagen (Avitene H) in coating weight ratios between 1 and 10 times the GO layer weight. Within this range of coating weight, no adverse effect was observed on the desalination performance of the GO. Use of collagen layers to sandwich the GO membrane, while further improving mechanical strength, adversely affected desalination performance. Standard six layer membranes exhibited salt rejection values of 94.2% and water flux of 0.55 gfd when values of 94.2% and water flux of 0.55 gtd when used with 0.5% NaCl solution at feed pressures of 600 psi. A one layer membrane exhibited a salt rejection efficiency of 90.5% and a flux of 1.0 gfd. Usable ammonium bentonite membranes were fabricated by use of poly-anionic additives. All bentonite membranes, regardless of the polyvalent additive used, could achieve salt rejection efficiency values above 60%. (Knapp-USGS) W70-09245

HYDROCASTING REVERSE OSMOSIS MEM-

Hydronautics, Inc., Laurel, Md.

R. Matz, M. P. Tulin, A. Gollan, H. S. Preiser, and

For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price \$1.25. US Office of Saline Water Research and Development Progress Report No 542, June 1970. 138 p, 34 fig, 16 tab, 17 ref, 3 append. OSW Contract No 14-01-0001-1727.

Descriptors: *Desalination apparatus, *Membranes, Desalination plants, Film, Membrane processes, Cellulose, Costs. Identifiers: Membrane hydrocasting, Tubular mem-

Hydrocasting provides a means for the in-situ formation of a tubular desalination membrane within a pre-assembled plant, flushing out the membrane a pre-assembled plant, flushing out the memorane as required, and regenerating fresh membrane surfaces, without dismantling the assembly and by techniques which may easily be automated. The support tube is filled with cellulose acetate casting solution prepared conventionally, and is forced through the system under pressure by means of an air or a gas column, thus forming an annular film of the solution on the wall of the support tube. Sub-sequently, the membrane may be heat-conditioned in-situ, by forcing hot water through the system for the required time. At no time should it be necessary to dismantle the plant for membrane replacement,

and for plants of sufficiently large capacity, the of the plant. A desalting plant utilizing the hydrocasting process was conceived and subjected to an engineering and economic analysis. (Knapp USGS) W70-09246

A METHOD FOR THE EVALUATION OF THE SYSTEM AND COST EFFECTIVENESS OF LARGE SEA WATER DISTILLATION PLANTSS Planning Research Corp., McLean, Va.

Albert Brown.

For sale by the Superintendent of Documents, UJ Government Printing Office, Washington, DO 20402 - Price \$1.00. US Office of Saline Water Research and Development Progress Report No. 539, Mar 1970. 100 p, 10 fig, 12 tab, 14 ref, 3 append. OSW Contract No 14-01-0001-1453.

Descriptors: *Desalination plants, *Flash distilla. tion, *Cost analysis, *Systems analysis, *Computer programs, Mathematical models, Value engineers ing, Design, Maintenance, Maintenance costs Operations.

Identifiers: *Cost-effectiveness analysis.

A method was developed for prediction of average distillation plant-effectiveness for each year of plant life, and for analysis of cost-effectiveness of variations in design concept and in maintenance procedures. Using the total cost of a variation and the associated plant-effectiveness, the variations which will result in reduced product water cost can be singled out by cost-effectiveness analysis. An Effectiveness Model was developed as well as a method for cost-effectiveness analysis. The Effectiveness Model embodies equipment performance characteristics and process thermodynamics for determination of overall desalting plant system-effectiveness. Subsystem-effectiveness is treated using general probability distributions of time-tofailure and repair duration for components. The computer program which was developed treats, parametrically, the specific distribution functions which adequately describe the failure and repair duration processes for the equipment under consideration. In order to demonstrate the methodolofectiveness analysis was performed on both the multistage-flash and combined-vertical-tube-flash processes and plant designs. (Knapp-USGS)

IMPROVEMENT OF TUBULAR CELLULOSE ACETATE MEMBRANES BY FEED ADDI-

TIVES, Philco-Ford Corp., Newport Beach, Calif.

Philico-Ford Corp., Newport Beach, Calif. Wayne J. Subcasky. For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. US Office of Saline Water Research and Development Progress Report No 532, June 1970. 96 p, 35 fig, 21 tab, 13 ref. OSW Contract No 14-01-0001-2201.

Descriptors: *Reverse osmosis, *Membrane processes, *Surfactants, Permselective memprocesses, *Surfactants, Permselective branes, Ion transport, Laboratory Semipermeable membranes, Permeability. Identifiers: Membrane improvement.

An investigation was made of the effectiveness of surface active agents as feed additives to improve membrane performance in terms of salt and urea rejection. Surfactant variables studied included charged and uncharged types, concentration, na-ture of the hydrophilic and hydrophobic groups, hydrophilic to hydrophobic ratio, molecular weight, and molecular arrangement of the hydrophilic and hydrophobic groups within the molecule. Poly (vinyl methyl ether) in the 50 to 100 ppm concentration range was an effective feed additive for improving the rejection of both NaCl and urea. For NaCl-containing feed solutions, improvements in salt reduction from 4 to 34% or in product flux from 8 to 18% were achieved. For a series of olyoxyethylene-nonylphenols, additive effectiveess was found to depend markedly upon the ydrophilicity of the additive. A cationic surfactant f the quaternary ammonium salt type gave improvements in excess of 400% in salt reduction or mprovements greater than 140% in product flux or NaCl-containing feed solutions. A proposed nodel for feed additives is presented in which ineraction of the hydrophilic groups of the additive and water decreases the ability of water to solvate he dissolved species in the feed solution. (Knapp-USGS) W70-09248

SUPERVISION, CONSTRUCTION AND EVALUATION OF A SEA WATER DESULFATING PROCESS PILOT PLANT, Catalytic, Inc., Philadelphia, Pa. C. E. Ennis, and Gideon Gelblum. CONSTRUCTION AND

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, DC 20402 - Price \$0.50. U S Office of Saline Water Research and Development Progress Report No 554, March 1970. 40 p, 4 plate, 3 tab, 7 ref. OSW Contract No 14-01-0001-2123.

Descriptors: *Descaling, *Desalination plants, *Distillation, *Sea water, *Sulfates, Ion exchange, Saline water, Gypsum, Calcium sulfate, Scaling, Water chemistry, Resins.

Identifiers: Barium.

Removal of sulfates should resolve most of the problems of high temperature scale formation in distillation desalination plants. A pilot sea water desulfating plant consists of two sections: a desulfating ion exchange cycle and a desulfating product recovery section. Raw sea water can be fed directly into the desulfating reactors or can be first decarbonated and then desulfated. Ion exchange resin in barium form is conveyed from the regenerated resin surge bin, and fed into the first Barium Exchanger. Aided by agitation, the resin is contacted by the sea water. By controlling the ratio of sea water to resin, a slight excess of barium ion is maintained in solution, causing precipitation of barium sulfate to take place in the sea water. The resin is thus converted to the sodium form. The exhausted resin recovered at the primary screen is rinsed with process water and rescreened by the Secondary Screen to be separated from the rinse water. It is then conveyed to the barium loading operation. (Knapp-USGS) W70-09354

DESIGN AND CONSTRUCTION SYSTEM FOR THE DETERMINATION OF TRANSPORT AND COMPACTION COEFFICIENTS OF REVERSE OSMOSIS MEMBRANES,

Hydronautics, Inc., Laurel, Md. R. Matz, and R. E. Kohl.

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, DC 20402 - Price \$1.50. In: Hydrodynamic Aspects of Desalination by Reverse Osmosis, Part 1: U S Office of Saline Water Research and Development Progress Report No 543, p 1-39, June 1970. 39 p, 15 fig, 4 tab, 7 ref. OSW Contract No 14-01-0001-1305.

Descriptors: *Desalination apparatus, *Reverse osmosis, *Permselective membranes, *Ion transport, *Laboratory tests, Permeability, Hydrodynamics, Osmosis, Semipermeable membranes. Identifiers: Membrane hydrodynamics.

Membrane transport coefficients are related to the phenomenological coefficients which relate the flow of water and solute through membranes under the influence of driving potentials across the membranes. At least three coefficients are required to characterize membranes and these, derived from theoretical analyses, are assumed to be independent of fluxes and driving potentials. In the case of reverse osmosis membranes, the three transport coefficients are: the filtration coefficient, (L sub P) the reflection coefficient, and the solute permea-

bility coefficient. The existence of compaction effects has been known for some time. A tentative analysis of the problem was made in which the effect was assumed to be confined to the porous backing. The effect of the reduction in void ratio which results is an increased resistance to flow and a decreased permeability to the diffusion of salt. A characterization or membrane-testing system designed using these considerations is described and shown diagrammatically. (See also W70-09357) (Knapp-USGS) W70-09356

THE DETERMINATION OF THE TRANSPORT COEFFICIENTS OF CELLULOSE ACETATE MEMBRANES.

Hydronautics, Inc., Laurel, Md. R. Matz, and C. Elata.

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, DC 20402 - Price \$1.50. In: Hydrodynamic Aspects of Desalination by Reverse Osmosis, Part 2: U S Office of Saline Water Research and Development. Progress Report No 543, p 40-93, June 1970. 54 p, 18 fig, 13 tab, 12 ref. OSW Contract No 14-01-001-1305.

Descriptors: *Desalination apparatus, *Reverse osmosis, *Membrane processes, *Hydraulics, *Ion transport, *Permeability, Osmosis, Permselective membranes, Semipermeable Hydrodynamics, Compaction. membranes,

Identifiers: *Membrane compaction, Membrane hydrodynamics.

Transport coefficients of anisotropic cellulose acetate membranes of the Loeb-Sourirajan type were determined by using two independent methods of the transport coefficients of the membranes and the subcoefficients for each of the two layers (dense and porous) of which they are composed. Values for the various coefficients are tabulated and related to membrane heat-treatment. Most of the membranes studied were made from a uniform and constant casting solution, and no other membrane systems were studied. Dense layer permeabilities are relatively constant for membranes of-the same heat treatment, even after prolonged pressurization. The permeability of the dense layer is significantly pressure related in short period tests made after an initial-set period during which the major initial compaction of the porous layer occurs. Hydrostatic permeabilities are substantially larger than permeabilities measured by osmotic means. This can only be attributable to internal polarization at the dense-porous layer interface, and there is some evidence to confirm this conclusion. (See also W70-09358) (Knapp-USGS)

COMPACTION THEORY FOR MODIFIED REVERSE OSMOSIS MEMBRANES, Hydronautics Inc., Laurel, Md.

C. Elata.

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, DC 20402 - Price \$1.50. In: Hydrodynamic Aspects of Desalination by Reverse Osmosis, Part 3: U S Office of Saline Water Research and Development Progress Report No 543, p 94-111, June 1970. 18 p, 3 fig, 1 tab, 9 ref. OSW Contract 14-01-001-1305.

Descriptors: *Desalination apparatus, *Reverse Osmosis, *Membrane processes, *Permeability, *Permselective membranes, Hydraulics, Hydrodynamics, Ion transport, Semipermeable membranes, Diffusivity, Laboratory tests, Compac-Identifiers: *Membrane compaction.

Compaction of modified Reverse Osmosis membranes reduces the water permeability of modified membranes under pressure with time. While it was found that both the rejection and the salt diffusivity remain approximately constant with time, the water permeability may decrease significantly. Ex-

perimental evidence indicates that plastic deformation or creep occurs during compaction and bears the major responsibility. A general equation for the compaction effect was derived. The analysis leads to a complicated semiempirical expression which may be approximated by a simple log-log relation-ship. (See also W70-09359) (Knapp-USGS) W70-09358

COMPACTION OF CELLULOSE ACETATE MEMBRANES,

Hydronautics, Inc., Laurel, Md.

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, DC 20402 - Price \$1.50. In: Hydrodynamic Aspects of Desalination by Reverse Osmosis, Part 4: U S Office of Saline Water Research and Development. Progress Report No 543, p 112-157, June 1970. 46 p, 21 fig, 5 tab. OSW Contract No 14-01-0001-

Descriptors: *Desalination apparatus, *Reverse osmosis, *Membrane processes, *Permeability, *Permselective membranes, Laboratory tests, Hydraulics, Hydrodynamics, Ion transport, Semipermeable membranes, Diffusivity, Compac-

Identifiers: *Membrane compaction.

A model was established for reverse osmosis membrane compaction as a function of time, pressure, and membrane permeabilities, based on analogous flux of water through packed clay beds. Experimental runs with membranes under pressure show that anomalous flow conditions occur at the very beginning of the tests, and steady conditions are achieved after some time, varying from 10 mins. to over 3 hours. Thereafter, the flow behavior under constant pressure load is typical and reasonably reproducible for different membranes prepared under the same conditions. It is not unlikely that anomalous behavior can be attributed to flawed membranes. It seems likely that there is an initial compression of the membrane resulting in the expulsion of water from the porous part of the mem-brane, followed by a much slower recovery which is nevertheless accompanied by positive flow. The subsequent increase in flow rate could be attributable to a rapid initial compaction resulting in further expulsion of water from within the membrane porous layer before the final steady state compaction is achieved. Variations in membrane thickness with time were plotted and appear to confirm this, and that the bulk of the compaction occurs very shortly after the application of pressure. (See also W70-09356) (Knapp-USGS) W70-09359

DISTILLATION DIGEST: VOLUMES 1 AND 2. Office of Saline Water, Washington, D.C.

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, DC 20402 - Price \$2.50. U S Office of Saline Water Research and Development Progress Report No 538, March 1970. 353 p, 149 fig, 30 tab, 5 ref.

Descriptors: *Desalination processes, *Distillation, Descriptors: *Desaination processes, Status Processes, *Abstracts, *Research and development, Design, *Engineering, Thermodynamics, Structural design, Laboratory tests, Pilot plants, Documentation, Model studies, Hydraulics, Heat transfer. Identifiers: Office of Saline Water.

Summaries are presented of reports by research contractors to the Office of Saline Water on development of distillation methods of desalination. This is one of a continuing series of reports designed to present accounts of progress in saline water conversion and the economics of its application. Such data are expected to contribute to the long-range development of economical processes applicable to low-cost dimineralization of sea and other saline water. (Knapp-USGS) W70-09360

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

WATER TECHNOLOGY, Rice (Cyrus Wm.) and Co., Pittsburgh, Pa. William E. Bell, Donald R. Brenneman, Ronald M. Burd, Robert E. Moore, and James K. Rice. For sale by the Superintendent of Documents, U S Government Printing Office, Washington, DC 20402 - Price \$1.25. U S Office of Saline Water Research and Development Progress Report No 536, March 1970. 156 p, 21 tab. OSW Contract No 14-01-0001-2139.

Descriptors: *Desalination processes, *Waste water treatment, *Desalination plants, *Reviews, *Technology, Engineering, Corrosion, Sealing, Design, Research and development, Brines, Saline water, Waste disposal, Water chemistry. Identifiers: Desalination technology

Saline and product water technology at the OSW Test Facilities at Freeport, Roswell, San Diego, Webster, and Wrightsville Beach are evaluated. Review and comments are presented on engineering reports, analytical methods, operational data sampling points and waterside problems such as seawater brine-formed deposits and product water corrosion. A detailed review is presented of chemical, physical, and instrumental techniques used in inorganic, organic, biological, and dissolved gas analyses applicable to desalination process en-vironments. (Knapp-USGS) W70-09361

DEVELOPMENT OF REVERSE OSMOSIS MEMBRANES.

Universal Water Corp., Del Mar, Calif. S. Manjikian, S. Liu, M. Foley, C. Allen, and B. Fabrick.

Available for sale by Superintendent of Documents, U S Government Printing Office, Wash, DC 20402 - Price \$1.00. U S Office Saline Water Research and Development Progress Report No 534, June 1970. 90 p, 19 fig, 20 tab, append. OSW Contract No 14-01-0001-2093.

Descriptors: *Membranes, *Reverse osmosis, *Cellulose, Desalination processes, Thin films, Permselective membranes, Semipermeable membranes, Laboratory tests, Membrane processes. Identifiers: Cellulose acetate butyrate.

Ultraselective membranes having adequate flux were produced from cellulose acetate butyrate as a film base. Salt rejection of 99.8% at a flux of 8-10 gal/sq ft day was achieved treating feed water of 5000 ppm NaCl at 600 psig. Using sea water as feed and an operating pressure of 1000 psig, a 99.7% rejection of total dissolved solids was achieved at a flux of 5 gal/sq ft day. These operating characteristics were obtained without heat treating the membrane. Proper choice of solvents and additives is a critical factor in the preparation of cellulose acetate butyrate membranes. Best results have been obtained using acetone as the principal solvent and triethyl phosphate as a modifying solvent with a combination of glycerol and n-propanol as a flux promoting additive. (Knapp-USGS) W70-09362

ENGINEERING AND ECONOMIC EVALUA-TION STUDY OF REVERSE OSMOSIS, Kaiser Engineers, Oakland, Calif.

F. L. Harris, G. B. Humphreys, H. Isakari, and G.

For sale by Superintendent of Documents, U S Government Printing Office, Wash, DC 20402 - Price \$3.75. U S Office of Saline Water Research and Development Progress Report No 509, December 1969. 506 p, 66 fig, 92 tab, 61 ref, 7 append. OSW Contract No 14-01-0001-1669.

Descriptors: *Desalination, *Reverse osmosis, *Water costs, *Economics, *Value engineering, Optimization, Mathematical models, Systems analysis, Cost analysis, Hydraulics, Fluid mechanics, Computer programs, Cost-benefit analysis. Identifiers: Reverse osmosis costs.

A parametric engineering and economic analysis of the reverse osmosis process was performed in which water costs were examined for demineralizing feedwaters with salinities of 2000, 3000 and 5000 ppm in plant sizes of 1, 10 and 50 mgd capacity, product water recoveries of 50, 60 and 80%, and operating pressures of 400, 600 and 800 psi. Capital and operating costs were prepared using state-of-the-art technology for tubular plate-and-frame, spiral wound, and hollow fine fiber reverse osmosis plant design concepts. Mathematical models were prepared to represent the hydrodynamic characteristics of each design concept. These models, in conjunction with computer codes were used to optimize plant design and operating parameters. Plant capital and operating costs were also prepared on the basis of anticipated improvements in reverse osmosis technology. (Knapp-USGS) W70-09363

3B. Water Yield Improvement

AN ENERGY BUDGET STUDY ABOVE THE FOREST CANOPY AT MARMOT CREEK, AL-

BERTA, 1967, Meteorological Service of Canada, Calgary (Alberta).

For primary bibliographic entry see Field 02D. W70-09111

ENERGY RELATIONSHIPS IN THE DESIGN OF FLOATING COVERS FOR EVAPORATION REDUCTION

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab. For primary bibliographic entry see Field 02D. W70-09112

WATER USE BY SALT CEDAR,

Geological Survey, Lubbock, Tex.; and Texas Tech Univ., Lubbock For primary bibliographic entry see Field 02D. W70-09113

EFFECTS OF FOREST CLEAR-FELLING ON THE STORM HYDROGRAPH,

Georgia Univ., Athens John D. Hewlett, and J. D. Helvey. Water Resources Research, Vol 6, No 3, p 768-782, June 1970. 15 p, 7 fig, 2 tab, 10 ref.

Descriptors: *Storm runoff, *Rainfall-runoff relationships, *Floods, *Clear-cutting, *Forest management, Conservation, Forestry, Hydrograph analysis, Watershed management, Flood control, Land management, Soil conservation, Infiltration, Evapotranspiration.
Identifiers: Experimental watersheds.

Earlier speculation that evapotranspiration from forests and the consequent soil water deficits under forests are factors in the mitigation of flooding was verified by a paired watershed experiment. Mature hardwood forest on a 108-acre catchment in the southern Appalachians was clear-felled after an 18-year calibration period. No forest material was removed, and no overland flow (surface runoff) occurred. A statistical analysis of all major storm curred. A statistical analysis of all major storm hydrographs before and after clearing revealed that after felling stormflow volume (quick flow) was significantly increased 11% overall, or 0.23 inch at the mean quick flow volume of 2.1 inches. Peak discharge increased slightly after felling (about 6 cfsm or 7% at the mean peak flow of 92 cfsm). Time to peak, recession time, and quick flow duration were tested to an accuracy within 10% of their tion were tested to an accuracy within 10% of their tion were tested to an accuracy within 10% of their mean values, but no treatment effect was detected. Quick flow increases due to felling ranged from 0 in small floods to 1.9 inches during a record 7-day flood sequence, a 22% increase over the total quick flow (8.7 inches) expected during that regional record flood. The effect of forest evapotranspiration on floodwater released by deep-soil slopes persists throughout the year, a result explainable : the variable source area concept of runoff. (Knap USGS) W70-09117

TRANSPIRATION OF PONDEROSA PINE AN DOUGLAS FIR AFTER TREATMENT WITH PHENYLMERCURIC ACETATE,

Arizona Univ., Tucson. Kenneth N. Brooks, and David B. Thorud. Water Resources Research, Vol 6, No 3, p 955 959, June 1970. 3 p, 1 fig, 2 tab, 7 ref.

Descriptors: *Evapotranspiration control, *Transpiration control, *Water yield improvements
*Forest management, Ponderosa pine tree Douglas fir trees, Chemcontrol.

Identifiers: Phenylmercuric acetate, Antitrans pirants.

Phenylmercuric acetate (0.001 M) reduced trans piration of ponderosa pine and Douglas fir in greenhouse without increasing foliage temper: tures. The reductions were 48% and 24%, respec tively, and the effect lasted at least seven day Some foliage on one treated tree of each specie showed browning four weeks after treatment. (k) napp-USGS) W70-09207

HYDROLOGICAL ANALYSIS OF VOLCANIO TERRANE: LOWER BASIN OF THE RIG GRANDE DE SAN MIGUEL, EL SALVADOR, Food and Agriculture Organization of the United

Nations, Kingston (Jamaica). David Wozab, and J. Roberto Jovel. Bulletin International Association of Scientifical Hydrology, Vol 15, No 2, p 47-66, June 1970. 20 pp 7 fig, 6 tab.

Descriptors: *Hydrogeology, *Irrigation water: *Water supply, *Water balance, *Rainfall-runofit relationships, Groundwater, Water levels, Water yield, Rainfall, Infiltration, Recharge, Runoff, Bases flow, Igneous rocks, Aquifers.

Identifiers: *El Salvador.

Standard hydrological methods were used to evaluate the water resources of a volcanic area that comprises the Lower Basin of the Rio Grande de Sam Miguel, El Salvador. The lower San Miguel Basin consists of a faulted valley situated at the base of a series of old and recent volcanoes bounding the valley on the East, a tuff block to the South, and consolidated volcanics (lahars) on the West and North. The valley fill consists of pyroclastics which diminish in particle size with distance from the volcances in the southern portion; however, the pyroclastics may be interbedded with lake deposits. A principal objective of the evaluation was to assess the feasibility of irrigating 10,000 hectares of the valley. Almost half of the annual precipitation infiltrates into the ground. Of this quantity, about one third is accounted for by the existing hydrological balance between recharge and depletion. The remainder moves from the valley to the San Miguel River as groundwater runoff and, if retained, is sufficient in quantity to meet the full anticipated irrigation demand. (Knapp-USGS)

A PREDICTION EQUATION FOR VEGETA-TION EFFECTS ON WATER YIELD FROM WATERSHEDS IN ARID AREAS,

Utah State Univ., Logan. Dept. of Soils and

B. L. Grover, C. B. Campbell, and M. D. Campbell. Soil Science Society of America Proceedings, Vol 34, No 4, p 669-673, July-August 1970. 5 p, 1 fig, 1 tab, 23 ref.

Descriptors: *Runoff forecasting, *Water yield, *Arid lands, *Soil-water-plant relationships, *Utah, Small watersheds, Water supply, Water yield improvement, Watershed management, Forest management, Land management, Water conservations

Conservation in Industry—Group 3E

Identifiers: Water yield forecasting.

A water yield prediction equation is based on plant type, water use profiles, and historic precipitation records. The equation can be set at any desired probability value. Yields predicted for sites occupied by deep-rooted brush species average 14 cm less per year than those for sites occupied by a grass-forb complex. This pattern holds for central Utah watersheds higher than 2,330 m above mean sea level in 4 out of 5 years. (Knapp-USGS) W70-09381

3C. Use of Water of Impaired Quality

DRY LANDS AND DESALTED WATER,

Oak Ridge National Lab., Tenn.

Gale Young. Sci, Vol 167, No 3917, p 339-343, Jan 1970. 5 p, 1 fig, 5 tab, 31 ref.

Descriptors: Desalination, *Demineralization, Sea water, *Irrigation water, Irrigated land, Irrigation efficiency, Crops, Land reclamation, Costs, Arid lands, Deserts, Coasts, Water sources, Agriculture, Water requirements, Graints (Crops), Water resources, Water costs, Bibliographies. Identifiers: Irrigated agriculture, Dual-purpose nuclear plants

nuclear plants.

A third of the world's land is dry and virtually unoccupied, while half of the population is jammed into a tenth of the land area. Mounting population pressure and the preference people seem to have for deserts indicate that the vast, warm dry areas of the world would be attractive for human occupancy if water and power needs were met. Since much arid land lies near the sea, seawater desalination is a potential fresh water source when inexpensive alternate sources are not available. Cities and industries can be developed along the ocean shore, bringing with them some agriculture for garden produce. A more difficult question is the extent desalinated water can be used for irrigation in arid lands for producing staple foods. A preliminary study at Oak Ridge National Laboratory, Tenn, the training transport forming in deserte dealt with intensive year-round farming in deserts, based on the use of distilled water in association with clustering industries. Production costs for rice and wheat are in the general area of recent grain prices, for water costs of around 35 to 20 cents per 1000 gal, respectively. These water prices are within the estimated future cost range for desalted water. Has 31 references. (USBR)

MIGRATION OF SOLUBLE SALTS IN AN IR-RIGATED FIELD IN RELATION TO RAINFALL AND IRRIGATION,

Department of Agriculture, Lethbridge (Alberta).
Water Resources Div.

D. N. Graveland.

Canadian Journal of Soil Science, Vol 50, No 1, p 43-45, Feb 1970. 2 fig, 3 ref.

Descriptors: *Alkaline soils, *Salinity, *Soil water movement, *Irrigation effects, *Rainfall, Irrigated movement, *Irrigation effects, *Kannan, irrigated land, Irrigation programs, Irrigation practices, Irrigation, Semiarid climates, Water table, Migration, Soil moisture, Soil water, Saline soils, Salts, Soil chemistry, Soil chemical properties, Precipitation (Atmospheric). Identifiers: *Soluble salts, *Alberta (Canada), *Irrigated activations of the soluble salts, *Alberta (Canada), *Irrigated activations of the soluble salts, *Alberta (Canada), *Irrigated activations of the soluble salts, *Alberta (Canada), *Irrigation salts, *Irrigation practices, *Irri

rigated agriculture.

An alkaline soil in a pasture near Vauxhall, Alberta (Canada) was studied in an effort to determine the effects of rainfall and irrigation on salt migration. The soil was sampled once a week during the growing season and then once every 10 days until January. The fluctuating water table of the area was traced by reading an observation well in the center of the test plot at the time of each sampling. The amount of water applied in the 3 irrigations was recorded and a rainfall record was kept. Changes in the concentration of soluble salts were compared

with water table levels, soil moisture content, and precipitation records. Soluble salt content varied over 100 percent during the growing season and was inversely related to moisture content. Caution is obviously required when sampling for salinity values during the growing season, because water application and evapotranspiration are then at a maximum. (Carr-Arizona)

SPACE HEATING IN URBAN ENVIRON-

Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 08C. W70-09192

USES OF WASTE HEAT,

Oak Ridge National Lab., Tenn.

S. E. Beall.

ORNL, some of which are sponsored by the U.S. Department of Housing and Urban Development. Oak Ridge National Laboratory Review, Spring 1970, p 9-14. 4 fig.

Descriptors: *Thermal powerplants, *Powerplants, Descriptors: "Inerman powerplants, Towerplants, Temperature Secretarian Security Security Secretarian Security mal pollution, Long tube vertical distillation, Evaporators, Aquatic algae, Horticultural crops, Poultry, Greenhouses, Fish farming, Irrigation

Identifiers: *Waste heat, *Uses of waste heat, *Central heating and cooling, *Space heating, *Farm uses of waste heat, Steam powered buses.

Presents new concepts for beneficial use of a large part of the heat discharged from the exhausts of turbines of fossil fuel or nuclear power plants. Both urban and rural sites offer opportunities for applying low temperature heat to useful purposes. Waste steam or hot water from power plants, between 300 deg F to 380 deg F, can be competitive with present urban space heating sources, even if the power plant is 10 miles from the heat distribution point. In most cities in the United States, more waste heat can be used for cooling, (in absorbtion systems) during the crucial summer period than is needed in the winter for residential and commercial heating. The average reduction in waste heat disposal that could be attained in this manner in urban areas is estimated to be 60 per cent. Other uses of the waste heat are discussed, including heating and cooling of greenhouses and poultry houses, and heating of aquaculture ponds. Evaporation of waste water and distillation of brackish or salt water for potable water supply or irrigation uses is considered feasible, but costly at present. Steam storage tanks to provide power for buses and switch engines are considered technically and economically feasible. The use of 104 deg F irrigation water is being studied in Oregon on several experimental farms. Similar studies are underway at Washington State University. A study of installations of underground pipes heated with condenser discharge water to stimulate growth of crops is underway at Oregon State University. (Poertner) W70-09193

EXPERIMENT IN THE LEACHING OF SALINE LAND IN SOUTHERN KAZAKHSTAN,

Ya. D. Kalinin.

Translated from Hydraulic Engineering and Reclamation (Gidrotekhnika i melioratsiya), No 8, p 66-75, 1969. Soviet Hydrology: Selected Papers, Issue No 2, p 201-209, 1969. 9 p, 2 fig, 8 tab, 7 ref.

Descriptors: *Leaching, *Saline soils, *Land reclamation, *Irrigation, Drainage, Irrigation effects, Irrigation practices, Salinity, Salt balance, Soil

Identifiers: *USSR, *Kazakhstan.

Saline lands in Kazakhstan were leached for the first time over a large area (1100 hectares) at state farm No. 1, located in the area of the Arys' Turkestan irrigation system (northwestern part of Chimkent Province). The site of this irrigation system is between the gently sloping piedmont plain of the Kara-Tau Ridge and the old alluvial plain of the Syr-Dar'ya River. The elevations of this area are 200-240 m and the slopes, 0.001-0.006. The mean annual precipitation is 184-210 mm with a weak maximum in the winter-spring period. The mean annual air temperature is 12-12.7 deg C. The frost-free period lasts 195 days with a mean daily temperature sum of 4300 deg C. The average annual relative air humidity is 53% and evaporative power reaches 1500 mm per year. Prior to leaching, a salt survey was performed. It was found that of the total area of the irrigated area, 38.6% was saline, including 29.8% with soil salinity ranging from 0.7 to 3.0%. The permissible residual salinity after leaching was found to be 0.3-0.4% with allowance for the composition of the initial salts. Leaching removed 145,000 metric tons of salts (69%), including 29,300 metric tons of the chloride ion (96%), from the upper meter of the soil, originally containing 211,000 metric tons of salt. (Knapp-USGS) W70-09258

3D. Conservation in Domestic and Municipal Use

CITY OF NEW YORK V NEW YORK WATER SERVICE CORP (CITY MAY ORDER AN IN-CREASE IN WATER SUPPLY).

274 NY 100, 8 NE2d 294-296 (1937).

Descriptors: *Water supply, *New York, *Cities, *Municipal water, Water demand, Water shortage, Waterworks, Water requirements, Administration, Legislation, Jurisdiction, Local governments, Planning, Water delivery, Water costs, Utilities, Administrative agencies, Judicial decisions, State governments, Remedies, Adjudication procedure, egal aspects Identifiers: Mandamus.

Over a period of several years plaintiff city repeatedly directed defendant water supplier to install additional water mains so that a greater supply of water could be provided to a certain area of the city. Defendant failed to comply. Plaintiff applied to the court for a peremptory order of mandamus compelling the defendant to install the additional mains. The court held for plaintiff, stating that the state public service laws gave the city water commissioner authority to provide for an increase in water supplies. Mandamus was a proper remedy to require adherence to the order, and, in a serious situation such as a shortage of water no hearing was required before issuance of the order. (Hubener-Florida) W70-09025

3E. Conservation in Industry

IN-PLANT WASTE REDUCTION, Humble Oil and Refining Co., Baytown, Tex. For primary bibliographic entry see Field 05D. W70-09316

FLEXIBILITY KEY TO DESIGN OF MACHIN-ING PLANT'S TREATMENT FACILITIES, Chrysler Corp., Detroit, Mich.
For primary bibliographic entry see Field 05D. W70-09326

A TEST OF FEDERAL WATER PROJECT EVALUATION PROCEDURES WITH EMPHASIS ON REGIONAL INCOME AND ENVIRON-

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3E—Conservation in Industry

MENTAL QUALITY: DETROIT TRENTON NAVIGATION CHANNEL, RIVER.

Michigan State Univ., East Lansing. Dept. of Agricultural Economics

A. Allan Schmid, and William Ward

Agricultural Economics Report No. 158, April 1970. 73 p, 10 tab, 3 plates, 1 append. Water Resources Council Agreement WRC69-6.

Descriptors: *Navigation, Industrial water, Leontief models, Cost-benefit analysis, Income analysis, Construction costs, Cost sharing decision making, Federal project policy, Federal budgets, Environmental effects.

Identifiers: *Water Resources Council Task Force Report, McLouth Steel Company, Detroit region, Lake Erie, Michigan Department of Conservation, US Army Corps of Engineers.

This report is an effort to apply the principles set forth by a Special Task Force of the U.S. Water Resources Council in their June 1969 report, Procedures for Evaluation of Water and Related Land Resource Projects. The Task Force encouraged potential effects to local incomes and to the environment from proposed water projects. In this study the proposed extension by the Army Corps of Engineers of the Trenton Channel which leads into the Detroit River in Michigan was examined. This project would enlarge the commercial navigational use of the channel and would thereby allow the McLouth Steel Company to develop a primary steel mill at Gibraltar, Michigan. The authors sought to determine how the actual costs and benefits of this project could be best predicted. Although their results were not conclusive, they stressed the need to study alternative locations and to view the proposed project in relation to the needs of other regions in the United States for navigational and industrial development. (Holmes-Rutgers) W70-09497

3F. Conservation in Agriculture

REDUCTION OF SEEPAGE LOSSES FROM IR-RIGATION CANALS AS A RESULT OF SILT-ING.

Research Inst. for Water Resources Development,

Budapest (Hungary). F. Papfalvy, O. Starosolszky, and Z. Szigyarto 13TH Congr Int Assn Hydraul Res, Proc Vol 4, p 299-309, Aug-Sept, 1969. 11 p, 7 fig, 5 ref.

Descriptors: *Seepage losses, Canals, *Irrigation canals, Observation wells, *Silting, *Permeability, Sealants, *Reduction, Boreholes, *Canal seepage, Seepage, Foreign research, Foreign design practices.

Identifiers: Hungary.

The irrigation canals built about 1960 in eastern Hungary are practically impervious up to a certain degree of fullness. Above the normal operating waterlevel, a sudden increase in seepage losses oc-curs, but decreases rapidly if the higher level is maintained for extended periods. Impermeability of the lower part of the canal cross section is caused by settling sediment, as demonstrated by soil mechanics tests and hydraulic investigations. The sealing effect of silting becomes observable in 1 to 2 yr. Silting as a stochastic process variable in time and space is described numerically in terms of soil type. (USBR)
W70-09043

HYDRAULIC DESIGN FOR CHECK METHOD

OF IRRIGATION,
Punjab Agricultural Univ., Hissar (India).
V. V. N. Murty.

Journal of Agricultural Engineering Research, Vol 14, No 4, p 319-322, Dec 1969. 4 ref.

Descriptors: *Hydraulic design, *Irrigation design, *Flood irrigation, *Water loss, *Deep percolation, Soil water movement, Soil water, Soil moisture,

Percolation, Irrigation water, Flow, Soils, Surface irrigation, Irrigation systems, Irrigation practices, Irrigation

Identifiers: *Check irrigation.

The check method of irrigation, which consists of irrigating rectangular plots surrounded by levees, has not been as thoroughly studied as the border strip or the furrow methods. The check method is, nonetheless, widely used. An expression is derived to help determine the size of the check for given stream size and soil conditions and to estimate deep percolation losses under the given conditions. Losses depend on the time necessary to initially cover the entire plot with water and when required time decreases, losses decrease. The procedure for designing the check method of irrigation is illustrated with an example. (Carr-Arizona) W70-09136

THE EFFECT OF SOIL MOISTURE LEVEL OF THE INCIDENCE OF EARLY BLIGHT ON POTATO AND TOMATO PLANTS,

National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research. For primary bibliographic entry see Field 02I.

EFFECT OF SOIL PROFILE TYPE AND FER-TILIZER ON MOISTURE USE BY WHEAT GROWN ON FALLOW OR STUBBLE LAND, Saskatchewan Univ., Saskatoon. Dept. of Soil

E. de Jong, and D. A. Rennie.

Canadian Journal of Soil Science, Vol 49, No 2, p 189-197, June 1969. 1 fig, 7 tab, 13 ref.

Descriptors: *Wheat, *Water utilization, *Slopes, *Fallowing, *Stubble mulching, Soil profiles, Crop production, Crop response, Soil moisture, Soil water, Water management (Applied), Fertilization, Semiarid climates, Great Plains, Soil-water-plant relationships, Precipitation (Atmospheric). Identifiers: *Saskatchewan (Canada), *Slope posi-

tion, *Water-use efficiency.

The effect on water utilization of fallowing, fertilizer use, and slope position was studied for wheat grown on the Canadian Prairies in the years 1960-1967. Yield, water consumption, and water-use efficiency of wheat grown on fallow land or stubble mulch varied according to whether the crop grew in a depression, on a lower slope, upper slope, or knoll. Although there were few significant differences between slope positions, yield and wateruse efficiency showed a tendency to increase down the slope. Data also showed that, in general, yields increased linearly with water use. (Equations describing yield as a function of moisture use are illustrated.) Second-degree polynomials represented more realistic yield functions, but did not greatly increase the correlations. Growth of yield per cm of water used increased with fertilization and was greater on fallow than on stubble land. Mean yields for unfertilized stubble and fallow wheat were 1,340 and 1,500 kg/ha, respectively. For fertilized stubble and fallow wheat the figures were 1,720 and 1,860 kg/ha, respectively. (Carr-Arizona) W70-09139

ON USING A TIME VARIABLE INFILTRATION WITH THE ISRAELSON BORDER IRRIGA-TION EQUATION, Saskatchewan Univ., Saskatoon. Dept. of Agricul-

tural Engineering.

Journal of Agricultural Engineering Research, Vol. 14, No 2, p 173-175, June 1969. 3 fig, 5 ref.

Descriptors: *Equations, *Border irrigation, *Flow rates, *Infiltration, *Water flow, Flow, Time, Irrigation systems, Surface irrigation, Irrigation. Identifiers: *Israelson border irrigation equation, *Rate of infiltration.

The author demonstrates why an equation for a a time variable infiltration rate (I=ct superscript -1/2) cannot be used in combination with the Israel-1 son differential equation for flow down an irrigation border (qdt=Ixdt+hdx). When using specific values of c and h, such a method greatly overestimates distance x for given time t. Also, c is overestimated when working from field data to arrive at cannot and h. An exact solution to the infiltration-advance problem is presented. (Carr-Arizona) W70-09141

DIGESTED SLUDGE DISPOSAL ON CROP' LAND.

Illinois Univ., Urbana; and Metropolitan Sanitary District of Greater Chicago, Ill.
For primary bibliographic entry see Field 05D.

FORAGE CROP IRRIGATION WITH OXIDA-TION POND EFFLUENT, Mississippi State Univ., State College. Water

Resources Research Inst. For primary bibliographic entry see Field 05D W70-09423

COLORADO V KANSAS (APPORTIONMENT OF WATER BETWEEN UPRIVER AND DOWNRIVER STATES).

For primary bibliographic entry see Field 06E. W70-09460

NEBRASKA V WYOMING (APPORTIONMENT OF INTERSTATE WATERS UNDER PRIOR AP-PROPRIATION).

For primary bibliographic entry see Field 06E. W70-09461

BURLEY IRRIGATION DIST VICKES (RIGHTS TO PROFIT FROM DAM OPERATION).

116 F2d 529-542 (DC Cir 1940).

Descriptors: *Idaho, *United States, *Irrigation districts, *Power operation and maintenance, Hydroelectric plants, Dams, Electric power production, Multiple-purpose projects, Irrigation, Governments, Irrigation operation and maintenance, Pumping plants, Economics, Prior appropriation, Irrigation programs, Water utilization, Water requirements, Operating costs, Power system operation, Net profit, Cost-benefit ratio, Judicial decisions, Legal aspects, Electric power demand, Federal reclamation law.

Plaintiff irrigation district and another district operated a dam for irrigation purposes with a secondary function of selling left-over power for commercial purposes. The United States owned the dam and had decreed that profits from the operation were to be distributed according to the proportionate usage of the water by plaintiff and the other district. Due to great seasonal variations in the amount of water used for irrigation, a continuous supply of power for commercial use could not be maintained, so defendant Secretary of the Interior contracted with a private power company for the needed extra power supply and sought to distribute part of the net profit to the private power company. Plaintiff sought to enjoin defendant from so distributing such profits. Plaintiff argued that this was an interference with its rights to part of the profit. The United States Court of Appeals for the District of Columbia ruled that the profits to be distributed did not stem directly from operation of the dam by plaintiff and that such contract with the private company was necessary to preserve the primary function of irrigation for which plaintiff's dam was designed. The court held that it was within defendant's discretion to allocate a portion of the profits to the power company. (Barker-Florida) W70-09472

Control of Water on the Surface—Group 4A

ALBION-IDAHO LAND CO V NAF IRRIGA-TION CO (PRORATION OF WATER RIGHTS UNDER PRIOR APPROPRIATION DOCTRINE). For primary bibliographic entry see Field 06E. W70-09474

UNITED STATES EX REL SIERRA LAND AND WATER CO V ICKES (GOVERNMENT GRANTS OF RIGHTS-OF-WAY OVER PUBLIC LANDS FOR IRRIGATION SYSTEMS). 84 F2d 228-232 (DC Cir 1936).

Descriptors: *Irrigation systems, *Water rights, *Right-of-way, *Public lands, Appropriation, Irrigation, Irrigation programs, Irrigation waters, Irrigation canals, Irrigation ditches, Canals, Conduits, Ditches, Water sources, Water requirements, Water utilization, Water conveyance, Judicial decisions, Legislation, Federal government, Public rights, Federal project policy, Administrative agen-

Pursuant to an act of Congress authorizing issuance of rights-of-way to canal and ditch companies over public lands for purposes of constructing canals and ditches for irrigation, plaintiff water company sought a writ of mandamus to compel the Secretary of the Interior to approve its application for such rights-of-way. The Secretary, pursuant to Department of the Interior regulations, had refused plaintiff's applications because of its failure to establish any right to the use of waters essential to the operation of the proposed irrigation system. The court held that the granting of rights-of-way over public lands for maintenance of ditches and canals for irrigation purposes was within the delegated authority of the Department of the Interior, but that the right to appropriate natural sources of water supply was determinative under state law. Thus a prior determination by the California supreme court that plaintiff had no right to the use of the waters relied upon for the operation of the proposed irrigation system justified the Secretary of the Interior in denying plaintiff's application for rights-of-way. The writ of mandamus was denied. (Snow-Florida) W70-09480

PADDY RATOONS,

Institute of Agricultural Research, Addis Ababa

(Ethiopia). C. R. K. Prashar.

World Crops, Vol 22, No 3, p 145-147, May/June 1970. 9 tab, 2 fig, 3 ref.

Descriptors: *Crop response, Water utilization, Meteorological data, Water levels, Crop produc-

Identifiers: *Paddy ratoons, (IR-8, IR-5), Institute of Agricultural Research, Melka Werer, Ethiopia.

This article provides data which demonstrates that growth of two varieties of rice (IR-8, IR-5) as paddy ratoons produces greater yields and uses less amounts of water than growth of rice as a main crop (first crop). The author tested various heights for ratooning and various dates for the first watering. Since the paddy ratoon matures in a shorter period of time than the main crop, it therefore uses less total water allowing for economy in irrigation. The author also points out that paddy ratooning offers the farmer labor saving advantages and at the same time can increase his rice yields considerably. (Holmes-Rutgers) W70-09501

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

RESERVOIR LEAKAGE IN LIMESTONE TER-RAINS.

Berlen C. Moneymaker. Bull Assn Eng Geol, Vol 6, No 1, p 3-30, Spring 1969. 28 p, 6 fig, 5 ref.

Descriptors: Reservoir construction, *Reservoir leakage, *Reservoirs, *Reservoir sites, Scepage, Limestone, *Damsites, *Dam foundations, Grout curtains, *Engineering geology, Leakage, Grouting, Cutoff walls, Foundation rocks, Underseepage, Dams, History, Dam construction.

Identifiers: Reservoir modifications, Seepage control, Cavernous rock, *Solution channels, Hales Bar Dam, Tenn, Great Falls Dam, Tenn.

Constructing watertight reservoirs in limestone terrain may be difficult and costly. Limestone may contain solution cavities, joints, bedding planes, and other open structures that serve as leakage paths. Solution channels may occur along reservoir rims and below streambeds to depths of hundred of feet. Most reservoirs selected after adequate exploration can be made sufficiently watertight by proper foundation preparation and treatment and by rim-tightening programs. Experiences with leaking reservoirs of the TVA are reviewed. Hales Bar and Great Falls reservoirs in Tennessee developed leaks immediately after impoundment. In both instances, leakage began along solution cavities and accelerated rapidly as flowing water under hydrostatic head removed clay, silt, or sand from filled or partially filled cavities. Leakage from Hales Bar Reservoir occurred through subriver cavities beneath the dam. At Great Falls, leakage was through the rim along tubular cavities developed on bedding planes. The leakage control programs at Hales Bar and Great Falls are described. (USBR) W70-09042

PREDICTIONS OF RESERVOIR LEAKAGE,

Dames and Moore, San Francisco, Calif For primary bibliographic entry see Field 02F.

LEAKAGE THROUGH BURIED CHANNELS,

Howard A. Coombs. Bull Assn Eng Geol, Vol 6, No 1, p 45-52, Spring 1969. 8 p, 5 fig.

Descriptors: *Reservoir leakage, *Leakage, Underground, Glaciers, Glacial deposits, Damsites, Channels, Freezing, Frozen ground, Rivers, Engineering geology, Glacial drift, Valleys, Geologic formations, Clays, Dams, Grout curtains, Drainage basins, Impervious blankets, Rockfill dams. Washington.

wasnington.
Identifiers: *Underground cavities, Glacial till,
Sultan Dam No I, Wash, Tolt River Dam, Wash,
Buried channels (Geology).

Continental glaciers moved southward several times during the Pleistocene in the Puget Sound area of western Washington. At the same general time, alpine glaciers moving westward down the cascade Range encountered the continental glaciers. The result was widespread disruption, diversion, and burial of previous drainage channels. These ancient buried drainage channels, existing along present riverbeds, can be the cause of reser voir leakage as dams are constructed. The Toltr River Dam, 30 mi east of Seattle, is in an en-trenched river with andesite flows forming the bottom and glacial drift forming the sides of the valley. Leakage through the permeable glacial material in the old channel was sealed by an impervious blan-ket. At the Sultan Dam, 35 mi northeast of Seattle,

the buried channel was filled with till forming an effective seal against leakage. Gorge Dam on the Skagit River presented a leakage problem only during construction. To prevent water from the old reservoir (400 ft upstream) from moving into the new deep excavation, a frozen subsurface seal 220 ft high was installed. Thorough exploration and imaginative methods of treatment of these buried channels may permit construction of many additional dams and reservoirs for future use. (USBR) W70-09049

RESEARCH INTO THREE-DIMENSIONAL SEEPAGE IN JOINTED ROCK FOUNDATIONS OF HIGH DAMS.

13th Congr Int Assn Hydraul Res, Proc Vol 4, p 151-158, Aug-Sept 1969. 8 p, 6 fig, 14 ref.

Descriptors: Anisotropy, *Seepage, *Flow nets, *Underseepage, Models, *Dam foundations, *Model studies, Three-dimensional, Rock foundations, Flow characteristics, Percolation, Foreign research, Two-dimensional, Soil mechanics, *Electric analogs, Analog models. Identifiers: Seepage control, USSR.

Theoretical justification and recommendations on methods of modeling using electrical analogy are presented for 3-dimensional percolation in an anisotropic medium. Specific reference is made to seepage through dam foundations. A procedure is suggested whereby 2-dimensional plan and eleva-tion models constructed from electroconductive paper are used to determine an approximate grouting and drainage scheme and a 3-dimensional model is used for refining the approximate scheme. Model studies made for a dam are described and results presented. Problems of seepage in anisotropic media can be reduced to problems of seepage in isotropic media by distorting dimensions of individual model zones and by separate con-struction and mounting of models of rock masses having differently oriented joints. (USBR) W70-09050

CROSBY V DE LAND SPECIAL DRAINAGE DIST (VALUE TO FARMLAND OF IMPROVED DRAINAGE SYSTEM).

367 III 462, 11 NE2d 937-942 (1937).

Descriptors: *Illinois, *Drainage districts, *Assess-Descriptors: *Illinois, *Drainage districts, *Assessments, *Direct benefits, Tiles, Drainage systems, Ditches, Surface waters, Drains, Property values, Land appraisal, Market value, Productivity, Drainage water, Local governments, Tile drainage, Surface runoff, Judicial decisions, Taxes, Farms, Land tenure, Benefits, Estimated benefits, Adjudication procedure. Legal aspects. cation procedure, Legal aspects.

Defendants, commissioners of a drainage district, planned to improve open drains in the district and made assessments against those lands which would receive benefits from the improvements. Plaintiffs, owners of assessed lands, claimed the assessments greatly exceeded the benefits which would accrue to their lands. The lower court heard conflicting testimony as to the need for the drainage improve-ment, its effects on the farmland, and its value to the land. The jury found for plaintiffs, returning a lower assessment on each tract of land. The Illinois supreme court affirmed, stating that the jury's finding was not against the weight of the evidence. The court stated that if the jury believed from a preponderance of the evidence that the assessments exceeded the benefits, it had a duty to lower the assessments. In considering the value of the improvements to the land it was proper for the jury to consider only the direct benefits of the improved drain and not a general rise in value of the property. (Hubener-Florida) W70-09051

DALY V STATE (FLOOD DAMAGES CAUSED BY CANAL CONSTRUCTION). 42 NE2d 14-15 (NY 1942).

Field 04-WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A-Control of Water on the Surface

Descriptors: *New York, *Flood damage, *Alteration of flow, *New York State Barge Canal canals, Construction, Crops, Streamflow, Natural flow, Floods, Canal design, Inland waterways, Navigation, Operation and maintenance, Judicial deciwatercourses (Legal).
Identifiers: *Lake Champlain.

Plaintiffs brought action against the State of New York for damages resulting from the flooding of their land. The land in question was situated on either side of Wood Creek, a stream which before 1908 flowed northerly and discharged into Lake Champlain. In 1908, the State, in constructing the Champlain branch of the Barge Canal through the Wood Creek Valley, substantially altered the flow of Wood Creek. Plaintiffs claim that these changes in the flow of the creek and the subsequent maintenance of the canal caused the flooding of their land and the destruction of their crops. The Court of Claims awarded money damages for this flood-ing and crop destruction. The Court of Appeals affirmed, per curiam. (Dearing-Florida) W70-09143

COMM'RS OF DRAINAGE DISTRICT NO 5 V ARNOLD (JUDICIAL INTERPRETATION OF DRAINAGE STATUTE).

383 III 498, 50 NE2d 825-830 (1943).

Descriptors: *Illinois, *Administrative decisions, *Legislation, *Drainage districts, Boundaries (Property), Judicial decisions, Jurisdiction, Legal aspects, Natural flow doctrine, Proprietary power, State governments, State jurisdiction, Drainage ditches, Drainage systems, Drainage engineering, Administrative agencies, Adjudication procedure.

Defendant connected tile drainage ditches running across his land with an open ditch constructed by plaintiff drainage district. Defendant's land was located outside the district. An Illinois statute stated that any person whose land lay outside a drainage district and, in the opinion of the district commissioners, benefitted from work done in said district, would be deemed to have voluntarily applied to be included in said drainage district and to be subject to all provisions of the statute. The Supreme Court of Illinois held that the statutory language placed jurisdiction of such matters solely in the hands of the commissioners of the districts. Consequently, plaintiff commissioners' decision that defendant benefitted from work done in its drainage district, and thus came within the purview of the statute, was not judicially reviewable. The lower court proceedings were therefore a nullity. (Clarke-Florida) W70-09154

THE OPTIMIZATION OF STORM-HOLDING TANKS: A PROBLEM OF WATER POLLUTION CONTROL,

Stanford Univ., Calif. For primary bibliographic entry see Field 05G. W70-09181

FLOOD PLAIN INFORMATION, COTTON-WOOD CREEK, GUTHRIE, OKLAHOMA. Corps of Engineers, Tulsa, Okla.

U S Army Corps of Engineers Flood Plain Report, May 1970. 31 p, 8 fig, 13 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *Oklahoma, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Guthrie (Oklahoma), Standard project flood, Intermediate regional flood.

Flooding of Cottonwood Creek, Guthrie, Oklahoma is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may

be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by zoning and sub-division regulations, the construction of flood prorection works, or by combinations of these approaches. (Knapp-USGS) W70-09220

PLAIN INFORMATION, SANTA VENTURA COUNTY, FLOOD CALIFORNIA.

Corps of Engineers, Los Angeles, Calif.

U S Army Corps of Engineers Flood Plain Report, March 1970. 39 p, 19 fig, 11 plate, 4 tab.

Descriptors: *Floods, *Flood damage, *California, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.

Identifiers: Ventura County (Calif), Santa Clara River (Calif), Standard project flood, Intermediate regional flood.

Flooding of the Santa Clara River, Ventura County, California is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS) W70-09221

METROPOLITAN ATLANTA GEORGIA, UTOY CREEK, NORTH AND SOUTH UTOY CREEKS. Corps of Engineers, Mobile, Ala.

U S Army Corps of Engineers of Flood Plain Report, June 1970. 38 p, 4 fig, 20 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *Georgia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood. Identifiers: *Atlanta (Georgia), Standard project flood, Intermediate regional flood.

Flooding of Utoy Creek, Atlanta, Georgia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS) W70-09222

INSTALLATION FOR NITRATE

REDUCTION,
Agricultural Research Service, Brawley, Calif.
Southwestern Irrigation Field Station; Soil Conservation Service, Fresno, Calif.; and Bureau of Reclamation, Sacramento, Calif. Land Resources

For primary bibliographic entry see Field 05G. W70-09228

FLOOD PLAIN INFORMATION, ALLEGHENY RIVER AND FIVEMILE CREEK, ALLEGANY, NEW YORK.

Corps of Engineers, Pittsburgh, Pa.

US Army Corps of Engineers Flood Plain Report, October 1969, 43 p, 7 fig, 10 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *New York, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.

Identifiers: Allegany (NY), Standard project flood, I Intermediate regional flood.

Flooding of the Allegheny River, Allegany, New York is described in a report of flood plains problems based on records of rainfall, runoff, and of historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by com-binations of these approaches. (Knapp-USGS)

PREPARATORY REPORT OF THE TECHNICAL SUBCOMMITTEE ON SNOW. Ministry of Works, Wellington (New Zealand). Water and Soil Div.

For primary bibliographic entry see Field 02C. W70-09351

FLOOD DAMAGE PREVENTION. Tennessee Valley Authority, Knoxville. For primary bibliographic entry see Field 10. W70-09364

FLOOD PLAIN INFORMATION, COYOTE CREEK, SAN FRANCISCO BAY TO ANDERSON RESERVOIR, SANTA CLARA COUNTY, CALIFORNIA. Corps of Engineers, San Francisco, Calif.

U S Army Corps of Engineers Flood Plain Report, February 1970. 26 p, 8 fig, 45 plate, 3 tab.

Descriptors: *Floods, *Flood damage, *California, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood. Identifiers: Santa Clara County (Calif), Standard project flood, Intermediate regional flood.

Flooding of Coyote Creek, Santa Clara County, California is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combination of these approaches. (Knapp-USGS) W70-09365

A NOTE ON THE ESTIMATION OF THE PARAMETERS IN LOGARITHMIC STAGE-DISCHARGE RELATIONSHIPS WITH ESTI-MATES OF THEIR ERROR,

For primary bibliographic entry see Field 02E. W70-09374

SMALL RESERVOIRS AND PONDS OF THE CENTRAL CHERNOZEM PROVINCES, RSFSR, Leningrad State Univ. (USSR). Limnology Lab. G. V. Lopatin.

Translated from Russian. In: Water Balance and Silting of Small Reservoirs in the Central Chernozem of the Russian Soviet Federal Socialist Republic; Collection of Papers Translated for U S Agricultural Research Service, p 3-26, 1967. 24 p, 2 tab, 21 ref.

Descriptors: *Reservoirs, *Ponds, *Chernozems, *Reservoir construction, Water supply, Irrigation, Water utilization, Lakes, Rivers, Water source, Rain, Snow, Vegetable crops, Discharge (Water), Forests, Reservoir design.
Identifiers: *USSR, Chernozem Provinces.

This article is a general study of small reservoirs and ponds of the Chernozem region of the USSR

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Control of Water on the Surface—Group 4A

with an emphasis on their utilization and efficient design. The study includes: classification of reservoirs; effectiveness of utilization of small reservoirs and ponds in the national economy; (irrigation, livestock production); present status of small reservoirs and ponds in the steppe and forest-steppe zones; and defects in planning, construction maintenance, repair, and operation of these water bodies. (See also W70-09312). (Gabriel-USGS) W70-09415

ELECTRONIC COMPUTER PROGRAM FOR HYDRAULIC ANALYSIS OF BOX CULVERTS (BPR PROGRAM HY-3), Bureau of Public Roads, Washington, D.C.

Bureau of Public Roads, Washington, D.C. For primary bibliographic entry see Field 08A. W70-09445

STUDY OF EROSION IN ROADSIDE DRAINAGE CHANNELS IN NORTH CAROLINA,

North Carolina State Univ., Raleigh. School of En-

gineering. Michael Amein, and H L Chu.

Available from NTIS as PB-191 397, \$3.00 in paper copy, \$0.65 in microfiche. North Carolina Study Report ERD-110-68-4, Apr 70.55p

Descriptors: *Drainage, *Road construction, Ditches, *Runoff, *Open channel flow. Identifiers: *Roadside drainage.

An extensive field study of the performance of roadside drainage channels in North Carolina against the action of erosive forces was conducted under this research. From the results of these field observations and measurements, a criteria for the design of stable roadside channels was developed. The report presents three methods of determining whether a triangular shaped roadside drainage channel will be stable if it is fully grassed, partially grassed or bare earth when the discharge to be carried, the slope of the channel bottom, the side slope of the channel, and the soil characteristics of the channel are known. (BPR)

MOHAWK CARPET MILLS, INC V STATE (FLOODING CAUSED BY STATE'S NEGLIGENCE IN CANAL CONSTRUCTION).

267 App Div 707, 48 NYS2d 96-99 (1944).

Descriptors: *New York, *Ice jams, *Flood damage, *Channel improvement, Canals, Ice, Icewater interfaces, Boulders, Ice loads, Legal aspects, Judicial decisions, Riparian land, Riparian rights, Riparian waters, Watercourses (Legal), Damages, Overflow, Flooding, Floodwater, Water spreading, Water injury, Dredging, Explosives.

Plaintiff carpet mill brought action against defendant state seeking to recover for damages caused by a flood and ice jam in the Mohawk River and barge canal. Defendant had converted the river into a barge canal and in so doing had altered the channel by widening it, thereby creating spoil accumulation. An ice jam had backed up to plaintiff's property, and, when the river rose following upstream rain, the ice and flood water came onto the property, crushing a wall of the mill and doing other serious injury. Plaintiff argued that the state should have taken action, such as dynamiting the jam, in order to protect waterfront property. De-fendant claimed that such jams had always freed themselves and that no action had appeared necessary to protect the property. The court held that damages are allowable to those suffering injury caused by the use or management of the state's canals, or by the neglect or misconduct of any officer of the state having charge thereof. The order of the lower court dismissing plaintiff's claim was reversed, and a new trial was ordered to determine the amount of damages. (Price-Florida) W70-09458

UNITED STATES V DICKINSON (GOVERN-MENT'S LIABILITY FOR EROSION CAUSED BY FLOODING).

331 US 745, 67 S Ct 1382-1386 (1947).

Descriptors: *West Virginia, *Condemnation, *Compensation, *Condemnation value, Overflow, Land reclamation, Judicial decisions, Legal aspects, Dams, Damages, Impounded waters, Impoundments, Navigable waters, Riparian land, Riparian waters, Eminent domain, Flooding, Flood damage, Easements, Evaluation, Erosion control, Bank erosion, Federal government, United States, Frosion

Identifiers: *Consequential damages.

Separate suits were brought by plaintiff landowners against defendant United States to recover the value of property taken by flooding and erosion caused by defendant's dam. The suits were consolidated for trial. Defendant contended that the actions were barred by the six year statute of limita-tions, but if the actions were deemed to have been timely brought, that the compensation awarded by the trial court for erosion was improper, as such erosion was merely consequential damage and not compensable. The court held that the taking which was the basis for the suits was not complete six years prior to the institution of said suits, and therefore such actions were not barred. The court stated that when the government takes property by flood-ing, it takes that property as well as that which inevitably washes away as a result of that flooding. If such erosion is in fact preventable by prudent measures, the cost of that prevention is a proper basis for determining damages. When plaintiffs' lands were taken, an obligation to pay for them then arose, and the fact that plaintiffs were permitted to reclaim portions thereof was irrelevant as to the creation of such obligation. The trial court's judgments for plaintiffs were affirmed. (Price-Florida) W70-09462

UNITED STATES V WILLIS (LIABILITY FOR FLOOD DAMAGE).

141 F2d 314-317 (4th Cir 1944).

Descriptors: *West Virginia, *Compensation, *Condemnation value, *Condemnation, Eminent domain, Federal government, Judicial decisions Legal aspects, Riparian land, Value, Property values, Appraisals, Evaluation, Damages, Rivers and Harbors Act, Flooding, Flood control, Dams, Dam construction, Navigable rivers, High water mark, Federal jurisdiction, Erosion control, Flood damage.

Plaintiff brought action to recover for flood damage which resulted from a dam constructed by defendant United States. Plaintiff was awarded damages in the trial court pursuant to the Rivers and Harbors Act of 1930. Defendant contended on appeal that the evaluation by the trial court of the land taken was improper, and that plaintiff was not entitled to an award for the loss of cribbing which was submerged when the new water level was established. The court, in affirming, held that the evidence supported the lower court's decision relating to the value of the property taken, and that the cribbing was plaintiff's property and he should be compensated for the loss thereof. The court stated further that the holding did not conflict in any way with previous decisions which held that consequential damages suffered in the exercise of the federal power to improve navigable streams are not recoverable. (Price-Florida)

UNITED STATES V WAUNA TOLL BRIDGE CO (OBSTRUCTION OF NAVIGABLE RIVERS). 130 F2d 855-857 (9th Cir 1942).

Descriptors: *United States, *Condemnation, *Bridges, *Navigable rivers, Appropriation, Administrative decisions, Community development, Easements, Eminent domain, Federal government,

Federal jurisdiction, Judicial decisions, Legal aspects, Proprietary power, Public benefits, Relative rights, Right-of-way, Watercourses (Legal), Damages, Navigable waters, Riparian rights, Compensation.

Defendant was granted the privilege of constructing a private bridge over the Columbia River by an act of Congress. Shortly after its completion, Congress authorized the construction of a federal dam two miles below it. Despite a congressional act requiring, at the expense of the owner, alteration of a bridge which at any time obstructs navigation, Congress authorized reimbursement of all bridge owners on the river for required alterations resulting from the higher level of the impounded waters. In addition to this amount, defendant received from plaintiff United States the proceeds of a condemnation proceeding for a flowage easement allowing plaintiff to back up water over the easement and 2 piers supporting defendant's bridge. Defendant, however, claimed further damages in the form of lost tolls, ferry expenses and increased maintenance expenses. The court held that, pursuant to the above mentioned acts, defendant had an absolute duty to bear all expenses related to removing its obstruction to navigation. The reimbursement and condemnation awards were thus discretionary, and defendant could not be heard to complain of the lesser, incidental expenses. (Clarke-Florida) w70-09466

PETERSON V UNITED STATES (PUBLIC WORK INCLUDES FLOOD CONTROL AND IMPROVEMENTS TO NAVIATION).
119 F2d 145-148 (6th Cir 1941).

Descriptors: *Federal government, *Projects, *Railroad relocation, *Claim (Contracts), Federal jurisdiction, Public benefit, Flooding, Flood control, Flood protection, Water management (Applied), Watershed management, Multiple-purpose projects, Administration, Economics, Management, Navigation, Project purposes, Project planning, Construction, Legal aspects, Judicial decisions, Legislation, Government supports, Supply contracts, Railroads. Identifiers: *Public work.

Pursuant to the implementation of a flood control and navigation improvement project by a con-servancy district and the federal government, it was necessary to relocate certain railroad tracks in order to prevent their being flooded. Therefore, the federal government entered into a formal contract with defendent contractor for the construction of the new railroad roadbed. In addition, defendant executed a bond with defendant surety pursuant to a federal statute requiring bond by any person who contracted with the United States for the performance of public work. A subcontractor of defendant contractor subsequently defaulted in payments for services and supplies, and, as result, plaintiff United States instituted a suit on the bond. Defendants denied all liability on the bond, claiming the work to be done under the contract was not public work, but benefited a privately owned railroad. The court stated that flood control and improvements to navigation involved public work within the meaning of the federal statute requiring bond because the public at large benefited from such work, even though private advantages could incidently be promoted. Therefore, the court held the bond was a valid and enforceable obligation. (Finman-Florida) W70-09471

GOODMAN V UNITED STATES (FEDERAL GOVERNMENT'S LIABILITY FOR FLOOD DAMAGE).

113 F2d 914-919 (8th Cir 1940).

Descriptors: *Flood damage, *Flooding, *Dikes, *Obstruction to flow, Damages, Engineering structures, Alluvium, Rivers, Navigable rivers, Naviga-

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A-Control of Water on the Surface

tion, Judicial decisions, Channels, Federal government, United States, Condemnation, Eminent domain, Alluvial channels, Floods, Barriers, Diversion, Water levels, Compensation. Identifiers: *Governmental immunity.

Plaintiff brought action against defendant United States to recover for flood damage to his crops and land, contending that defendant, in constructing dikes to improve navigation, had diverted the flow of the river adjacent to his alluvial land in such a manner as to cause the natural level of intermittent flood waters to be raised artificially, thus causing his land to be flooded. Defendant contended that plaintiff could not maintain his action because such action sounded in tort, and the federal government was immune from tort actions. The court held that plaintiff had failed to show that the damages constituted a taking of property within the meaning of the fifth amendment so as to require compensation. Plaintiff had to show that there was permanent, as opposed to temporary, damage in order to be able to maintain a suit against the government. Since there was no such showing, the instant action did sound in tort, and defendant was immune to it. (Snow-Florida) W70-09473

INLAND POWER AND LIGHT CO V GRIEGER (FLOOD DAMAGE FROM NEGLIGENT DAM OPERATION).

91 F2d 811-819 (9th Cir 1937).

Descriptors: *Washington, *Flood damage, *Dams, *Reservoir operation, Floods, Flooding, Flood control, *Erosion, Reservoirs, Historic flood, Floodgates, Discharge (Water), Impounded waters, Water levels, Rainfall, Precipitation intensity, Excessive precipitation, Supercritical flow, Velocity, Flow rates, Average flow, Judicial decisions, Legal aspects, Flow augmentation.

Plaintiff riparian landowner brought action against defendant power company for damages which resulted from defendant's allegedly negligent operation of its dam, which was located upstream from plaintiff's property. Plaintiff argued that during unusually heavy rain, defendant discharged such amounts of water that its reservoir that valuable soil was eroded from his property and sand and gravel were deposited in its place. Defendant claimed that the damage caused to plaintiff's land was the result of an 'act of God', and that it had acted reasonably in discharging the excess water into the river. The Ninth Circuit Court of Appeals, in affirming the trial court's judgment for plaintiff, ruled that where damage results from defendant's negligence and an 'act of God' as concurring causes, defendant is liable to the same extent as though the damage has been caused by his negligence alone. (Barker-Florida)

UNITED STATES V CHICAGE B AND Q RR (EXTENT OF JUST COMPENSATION IN CONDEMNATION PROCEEDING). 22 F2d 131-141 (8th Cir 1936).

Descriptors: *Condemnation value, *Eminent domain, *Floodways, *Easements, Dams, Flooding, Design flood, Structures, Floods, Judicial decisions, Rivers, Mississippi River, Banks, Navigable rivers, Navigation, River flow, Federal government, Railroads, United States, Flood damage, Compensation, Condemnation, Legal asepcts, Right-of-way, Damages, Backwater.

The United States brought a condemnation suit for a flowage easement over lands flooded by a dam constructed in the interest of navigation. The condemned lands constituted an embankment supporting defendant's railroad tracks. Defendant contended that it was entitled to the value of lands actually flooded plus damages resulting to the remainder of the land as a result of the effects of saturation, wave action and distortion of ice which

would harm the tracks and necessitate expensive repairs. Plaintiff admitted that defendant was entitled to the value of the land actually flooded, but contended that no responsibility existed as to the damages to the unflooded land. The court held that the meaning of 'taken', which required compensation under the fifth amendment, had been expanded to mean 'taken or damaged'. Thus where a portion of land is taken, just compensation includes all direct damages which arise out of such appropriation, including damages to the remainder of the property. Consequently, defendant was entitled to the value of the land flooded and to the damages which were a direct result from such flooding. (Snow-Florida) W70-09482

CITY OF PHILADELPHIA V STANDARD OIL CO (USE OF PUBLIC BULKHEAD BY RIPARIAN OWNER).

79 F2d 764-767 (3rd Cir 1935).

Descriptors: *Bulkheads, *Pennsylvania, *Channel improvement, *Sediment control, Engineering structures, Structures, Walls, Retaining walls, Navigation, Docks, Judicial decisions, Dredging, Legal aspects, Bulkhead line, Rivers, Banks, Riparian rights, Riparian land, Navigable waters, Navigable rivers, Channels, Channel flow, Bank stability, Legislation, Relative rights.

Plaintiff municipality constructed bulkheads along the banks of a navigable river pursuant to legislative authorization. The act provided that riparian owners who made use of the bulkheads for wharf purposes were under a duty to pay to the municipality the cost of the bulkhead to the extent used. Plaintiff brought action against defendant oil company to recover the cost of a portion of the bulkhead, contending that defendant, in dredging a ship basin in front of the bulkhead, had used the bulkhead as an aid in preventing the river's banks from sloughing into the basin so as to be under a duty to pay the city for so using the bulkhead. Defendant contended that the act did not apply where the bulkhead was utilized as an aid to dredging operations. The court held that the act imposed upon riparian owners a duty to pay for the bulkhead only when it was used for wharf purposes, and that the activity of defendant was not of such purpose. Consequently, defendant was under no duty to pay the city for the cost of the bulkhead. (Snow-Florida) W70-09483

COOPER V CITY OF BOGALUSA (FEDERAL RESPONSIBILITY FOR DAMAGES CAUSED BY NAVIGATION IMPROVEMENTS). 195 La 1097, 198 So 510-513 (1940).

Descriptors: *Louisiana, *Federal government, *Dredging, *Access routes, Navigable waters, Local governments, Legal aspects, Judicial decisions, Damages, Condemnation, Right-of-way, Channel improvement, Canal construction, Navigation, Compensation, Eminent domain, Legislation, Dams, Locks, Cost sharing.

Plaintiff landowner, whose land allegedly was isolated and access to it cut off by action of the United States in dredging a navigable river, sued defendant city for damages. Plaintiff contended that the city was liable since: (1) the United States was acting as agent of the city; (2) the city had provided the land for the government to build dams and locks on; and (3) the city had agreed to assume responsibility for all property damage incident to such construction. The court held that plaintiff had no cause of action against the city. The United States was not acting as agent of the city so as to render the city liable as a principal where the river improvement was for navigation purposes exclusively under the federal commerce powers and where the work was solely under government control. The city's responsibility for damages extended only to those damages which might be assessed against the United States. (Hubener-Florida) SCOTT V RED RIVER-BAYOU PIERRE LEVEE AND DRAINAGE DIST (RIGHT TO COMPENA SATION FOR EXPROPRIATED LAND). 7 So 2d 429-433 (La Ct App 1942).

Descriptors: *Louisiana, *Drainage districts,s *Drainage systems, *Eminent domain, Canals,s Damages, Compensation, Drains, Local governments, Legal aspects, Judicial decisions, Property; value, Bridges, Assessments, Appraisals, Costs,s Flood damage, Land tenure, Right-of-way, Construction.

Plaintiff landowner brought action against defendant drainage district for damages caused to here land when the district undertook the widening and deepening of a natural drain located on her property. Plaintiff sought recovery for: (1) land covered by spoil dirt extending 100 feet from the edge of the canal; (2) land damaged by overflowing drainage water; and (3) defendant's failure to construct a bridge over the canal. The court granted recovery only for the land actually used, i.e. that portion covered by the spoil dirt. The court held that plaintiff failed to state a cause of action with respect to the land damaged by overflow because she had not alleged either that the land had been assessment. The failure to construct the bridge was not compensable since such a structure did not come within the constitutional provision requiring the drainage district to pay for 'property used or destroyed.' (Hubener-Florida)

MEYERING LAND CO V SPENCER (DRAINAGE DISTRICT HAS NO POWER TO CONSTRUCT SEWERS UNDER AUTHORITY FOR DRAIN CONSTRUCTION). 273 Mich 703, 263 NW 777-780 (1935).

Descriptors: *Michigan, *Drainage districts, *Sewers, *Administrative decisions, Drains, Pipes, Pipelines, Concrete pipes, Local governments, Adjudication procedure, Judicial decisions, Legal aspects, Decision making, Drainage programs, Economic impact, Water law, Surface drainage, Drainage systems, Septic tanks, Sewage disposal, Closed conduits, Sewage, Taxes, Assessments, Remedies.

Plaintiff landowners sued defendant drain commissioner to set aside and declare fraudulent certain proceedings laying out and establishing a drainage district, and to enjoin the collection of related tax assessments. Plaintiffs claimed that the drains were not laid out for the drainage of surface water, but as sewage facilities for certain subdivisions. Defendant contended that the proceedings were not subject to judicial review and could only be attacked through certiorari. The evidence established that the 'drains' followed the streets of the subdivisions, included a six-inch Y for every lot and were laid with sealed, watertight joints which prevented any surface drainage and that the natural drainage of the property was more than adequate. Reversing a judgment for defendant, the court held that defendant had no power to construct a sewer system in pursuance of a petition proceeding for a drainage system, and defendant's action was reviewable since it was outside his authority, although certiorari is the only remedy where the claim is that the authority was improperly exercised. (Liptak-Florida)

MAFFEI V BERRIEN COUNTY (COUNTY'S LIABILITY FOR FLOOD DAMAGE CAUSED BY NEGLIGENT MAINTENANCE OF DRAINAGE SYSTEM). 293 Mich 92, 291 NW 234-236 (1940).

Descriptors: *Michigan, *Local governments, *Drainage practices, *Flood damage, Drainage, Surface drainage, Ditches, Drainage effects, Governments, Floods, Damages, Drainage water, Cities, Legal aspects, Judicial decisions, Water law, Excavation, Overflow, Streams, Surface runoff, Dredging, Channel improvement, Outlets.

Plaintiff farmer brought an action against defendant county for damages caused by flooding. The creek which flowed through plaintiff's farm was the drainage outlet for the natural and artificial drains running through neighboring land. The county drain commissioner cleaned, deepened, and widened these drains to increase their drainage capacity, but did not perform any work on the outlet creek. As a result the creek overflowed, damaged plaintiff's land and crops. Plaintiff contended that this was negligence, and that defendant had a duty to protect landowners from such damage. Defendant contended that it was not liable for the negligent acts of its officers or agents in the absence of statutory provision. The court held that, as a general rule, counties and municipalities are not liable for the actions of their officers and agents since they are involuntary corporations created by the state and in the state's behalf. The court held that the duties imposed by law upon the county drain commissioner were not defendant's duties, therefore the negligent acts of the commissioner were not the acts of defendant. Defendant's motion to dismiss was granted. (Liptak-Florida) W70-09492

MILLER V MONONA COUNTY (DRAINAGE DISTRICT LIABILITY FOR NUISANCE). 294 NW 308-311 (lowa 1940).

Descriptors: *Iowa, *Drainage districts, *Drainage, *Floods, Judicial decisions, Legislation, Administration, Drains, Flooding, Flood damage, Legal aspects, Drainage systems, Washouts, Rainfall, Dikes, Diversion, Diversion structures, Levees, Local governments. Identifiers: *Nuisance.

Defendant was a drainage district whose facilities were claimed by plaintiff landowners to constitute a nuisance by increasing damage caused by floodwaters. The trial court ordered the district to abate the complained of nuisance. The Supreme Court of lowa reversed, stating that drainage districts are creatures of statute and are incapable of creating nuisances when operating within the ambit of their constitutional authority. Nuisance statutes do not apply to properly operated drainage districts. The trial court in the instant case was without authority to order alteration of the structures of the drainage district on the ground that the structures constituted a nuisance. (Dye-Florida)

HOGUE V WONONA-HARRISON DRAINAGE DIST (PROTECTION OF PRIVATE PROPERTY FROM FLOODING CAUSED BY DRAINAGE IMPROVEMENTS).

296 NW 204-209 (Iowa 1941).

Descriptors: *Iowa, *Drainage districts, *Dikes, *Flooding, Judicial decisions, Legislation, Legal aspects, Missouri River, Taxes, Structures, Flood control, Flood protection, Levees, Surface drainage, Drainage effects, Drainage programs, Surface waters, Drainage, Floods, Floodgates, Drainage systems, Alteration of flow, Obstruction to flow, Surface runoff, Flood damage.

Plaintiff held upland property partly within defendant drainage district. Prior to action by the drainage district, plaintiff's land was sufficiently drained by a creek which emptied into a nearby river. After construction by the district of dikes along the river below plaintiff's property, floodwaters were backed up, damaging plaintiff's property. Plaintiff sought to require the drainage district to construct floodgates or other means of protecting his property from floodwaters. Defendant alleged that it was without statutory power to construct floodgates to protect plaintiff's land, part of which was outside the district. Furthermore, the construction of the dikes was within the proper exercise of powers of the district. The trial court ordered the district to protect plaintiff's land either by raising the level of dikes bordering the creek to the level of the dikes along the river or by providing

floodgates. The Supreme Court of Iowa affirmed. Floodgates are part of a drainage system, and a drainage district is empowered to build them. A drainage district is empowered and obligated to protect lands flooded as a result of its activities. (Dye-Florida) W70-09494

TOWN OF WAUSAUKEE V LAUERMAN (LIABILITY FOR FLOOD DAMAGES). 240 Wis 320, 3 NW2d 362-366 (1942).

Descriptors: *Wisconsin, *Dams, *Flood damage, Judicial decisions, Legal aspects, Legislation, Flooding, Floods, Bridges, Washouts, Recreation, Reservoirs, Damages, Risks, Rainfall, Rain, Governments, Local governments, Highways, Storms, Dam failure, Remedies, Excessive precipitation, Rivers.

Defendant landowner constructed a dam on a river which flowed through his property for the creation of a recreational pond. The dam broke following a heavy rainfall and damaged plaintiff town's property downstream. Plaintiff charged: (1) that defendant was liable under a statute imposing strict liability for damages caused by interference with the natural course of a stream; or (2) that defendant was negligent in maintaining the dam. Defendant denied that strict liability applied and contended that the rainfall was too heavy to foresee. The Supreme Court of Wisconsin held that the statute relied upon by plaintiff imposes strict liability for damages caused by the mere existence of a properly operated dam. Other damages are to be judged on the basis of negligence. Defendant was negligent only if the volume of rain and the consequent damage was foreseeable. The jury found the rainfall to be unusual for the area and not foreseeable by a reasonable and prudent man. Since foreseeability is a fact question, the jury's finding for defendant was upheld. (Dye-Florida) W70-09495

ROCKFORD PAPER MILLS, INC V CITY OF ROCKFORD (FLOOD DAMAGE TO DAM AND OTHER PROPERTY FROM NEGLIGENT DAM OPERATION).

OPERATION).311 Mich 100, 18 NW2d 379-382 (1945).

Descriptors: *Michigan, *Dams, *Cities, *Impounded waters, Flow control, Rain, Ice, Judicial decisions, Legal aspects, Damages, Municipal water, Flood damage, Islands, Floodgates, Flooding, Dam failure, Excessive precipitation, Riparian rights, Diversion, Rivers, Public utilities, Water works, Water supply, Flow augmentation.

Plaintiff paper company owned a mill, land and a dam downstream from defendant city's dam. As a result of the melting of a heavy winter snowfall and an unusually heavy rainfall, the flow of the river upon which the dams were situated was significantly increased. The increased flow necessitated defendant's opening of its floodgates to maintain a normal water level behind its dam. As a result of the increased river flow, plaintiff's dam was damaged. Plaintiff brought action to recover these damages which it alleged resulted from defendant's negligent operation of its dam. The court held that defendant had a right to discharge water from its pond faster than it flowed in so as to reduce the elevation of the pond and facilitate its business. To hold defendant responsible there must have been a finding of negligence or an intention to release impounded waters to damage plaintiff's dam. No such finding had been made, and defendant could not be held responsible for a superfluity of waters coming from a flood condition arising above its dam. (Barnett-Florida) W70-09496

4B. Groundwater Management

ELECTROLYTIC MODEL STUDY FOR COL-LECTOR WELLS UNDER RIVER BEDS, New Mexico Inst. of Mining and Technology, Socorro. For primary bibliographic entry see Field 02F. W70-02210

COMMON ERRORS IN DEVELOPING A GROUNDWATER AQUIFER, Geological Survey, Louisville, Ky. Water Resources Div. For primary bibliographic entry see Field 02F. W70-09225

HYDROLOGICAL ANALYSIS OF VOLCANIC TERRANE: LOWER BASIN OF THE RIOGRANDE DE SAN MIGUEL, EL SALVADOR, Food and Agriculture Organization of the United Nations, Kingston (Jamaica). For primary bibliographic entry see Field 03B. W70-09370

GROUNDWATER RECORDS OF SOUTH CAROLINA - 1966, Geological Survey, Columbia, S.C. For primary bibliographic entry see Field 02F.

4C. Effects on Water of Man's Non-Water Activities

WATER AS AN URBAN RESOURCE AND NUISANCE, Geological Survey, Washington, D.C.

Geological Survey, Washington, D.C.
Harold E. Thomas, and William J. Schneider.
Available free on application to the US Geological
Survey, Wash, DC, 20242. US Geological Survey
Circular 601-D, p D1-D9, 1970. 9 p, 15 ref.

Descriptors: *Water resources, *Floods, *Urbanization, Water supply, Flood control, Rainfall-runoff relationships, Social aspects, Cities, Legal aspects, Water rights, Water law, Water resources development.
Identifiers: Urban hydrology.

Many urban activities are concerned with development and use of the land and its resources other than water; these activities affect the natural water flow system and are affected by it. The development and use of water may create nuisances if they adversely affect the use of the land and solid-earth resources and invade recognized property rights. Conversely, the development and use of the land resources may have effects on water that interfere with the rights of others and thus cause nuisances. In urbanized areas, water as a resource becomes increasingly inadequate to meet the requirements of the concentrated population and industry; it must be imported from other areas. Buildings and pavements inhibit groundwater recharge and promote rapid runoff from storms. Increased flood peaks cause erosion and sediment transport, as do various construction activities. Vulnerability to floods is increased by urban encroachment upon floodplains. In these and many other ways water causes inconvenience or annoyance to urban life and damage to property and thus constitutes a nuisance. urban water problem can be solved, but only if a complete understanding of the role of water in the urban environment--and indeed in the overall water picture-is realized. Such understanding can be achieved through the proper interpretation of adequate date. (Knapp-USGS) W70-09129

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4C-Effects on Water of Man's Non-Water Activities

NEW YORK METROPOLITAN REGION--A MAJOR SEDIMENT SOURCE,

State Univ. of New York, Stony Brook. Marine Sciences Research Center.

For primary bibliographic entry see Field 02J. W70-09203

FLOOD PLAIN MANAGEMENT - IOWA'S EX-

Iowa State Univ., Ames. Dept. of Civil Engineering. For primary bibliographic entry see Field 06F. W70-09253

EVALUATION PROCESSES RESOURCES PLANNING. IN WATER

American Water Resources Association, Urbana, Ill.

For primary bibliographic entry see Field 06B.

W70-09369

4D. Watershed Protection

MORPHOLOGY OF GULLIES IN THE COLORADO ROCKY MOUNTAINS, Forest Service (USDA), Fort Collins, Colo. Rocky

Mountain Forest and Range Experiment Station. Burchard H. Heede.

French resume. Bulletin International Association of Scientific Hydrology, Vol 15, No 2, p 79-89, June 1970. 11 p, 2 fig, 3 tab, 9 ref.

*Gullies, *Gully Rocky Mountain Region, Sediment yield, Vegetation effects, Drainage patterns (Geologic).

A classification of gullies into discontinuous and continuous channels not only expresses differences in channel morphology and stage of development, but also presents helpful criteria for design of gully control. The term 'critical location' was introduced for those locations within gullies that are obviously susceptible to changes, and whose direction of change is suggested. Regression analyses underlined the fact that the gullies constituted channels of youthful stage if relations between components in channel geometry were considered. (Knapp-W70-09372

WATER EROSION, THE FORMING OF SEDI-MENT FLOW OF SMALL STREAMS IN THE CENTRAL CHERNOZEM PROVINCES AND MEASURES FOR PROTECTING RESERVOIRS FROM SILTING,

For primary bibliographic entry see Field 02J. W70-09414

PAYNE V MISSOURI VALLEY DRAINAGE DIST NO 1 (CONSTRUCTION OF NEW SET-TLING BASIN AS REPAIR OF OLD BASIN).

272 NW 618-624 (Iowa 1937).

Descriptors: *Iowa, *Drainage districts, *Repairing, *Settling basins, Ditches, Drainage, Drainage effects, Drainage practice, Flood routing, Tile drainage, Sediments, Silts, Channel improvement, Drainage systems, Sediment control, Administrative decisions, Judicial decisions, Water law, Legal aspects, Right-of-way, Condemnation, Administration, Relocation, Assessments.

Plaintiff landowner brought action to enjoin defendant drainage district's construction of a new set-tling basin which would divert water from the old ting basin winch would divert water from the old basin through a drainage ditch on plaintiff's land. Plaintiff alleged that silt and sediment from the old basin would fill up the ditch, rendering his tiled drainage system worthless. Plaintiff further con-tended that this new drainage plan required statu-tory notice and reclassification of the land. Defendant contended that, since the old basin was completely filled with silt and sediment, it was merely making repairs, for which no notice or reclassification was required. Affirming the dismissal of plaintiff's petition, the court held that the construction was obviously repair work since it was done solely to keep the drainage system functioning, the old basin being filled with silt and sediment. Therefore, no notice or reclassification was required. (Liptak-Florida) W70-09490

05. WATER QUALITY MANAGEMENT AND **PROTECTION**

5A. Identification of Pollutants

A STUDY OF THE HYDROCHEMICAL FACIES OF THE WILCOX AQUIFERS IN MISSISSIPPI, Mississippi State Univ., State College. Water Resources Research Inst. For primary bibliographic entry see Field 02K. W70-09095

ANALYSIS OF LAG PHASE BOD CURVES USING THE MONOD EQUATIONS, Heinz B. Braun, and Paul M. Berthouex.

Water Resources Research, Vol 6, No 3, p 838-844, June 1970. 7 p, 8 fig, 1 tab, 13 ref.

Descriptors: *Biochemical oxygen demand, *Mathematical models, Mathematical studies, Oxygen demand, Oxygen sag, Water quality, Water pollution effects, Biodegradation, Nutrients. Identifiers: *Monod equations, Reaction rates.

The Monod biokinetic relations are used to develop a 3-parameter model to describe the biochemical oxidation of waste water substrates observed in biochemical oxygen demand (BOD) tests, including those tests with an initial lag phase. A criterion relating the biological parameters of the model to the occurrence of a lag phase is presented. The model was applied to several sets of data that reflect a variety of conditions. Some statistical problems involving parameter correlation were noted. (Knapp-USGS)

RESERVOIR EFFECT ON DOWNSTREAM WATER TEMPERATURES IN THE UPPER DELAWARE RIVER BASIN,

Delaware River Basin Commission, Trenton, N.J. Owen G. Williams.

US Geological Survey Prof. Paper 600-B, p B195-B199. 5 fig, 1 tab, 1 ref.

Descriptors: *Water temperature, *Delaware River, *Reservoirs, Hydrographs, Mass-curves, Climatic data, Mathematical models, Watersheds (Basins), River flow, Air temperature, Hypolim-

Identifiers: Thermographs.

Seasonal water-temperature data were obtained at five sites in the upper reaches of the Delaware River. The data were graphically analyzed by plotting and double-mass curves. Hydrographs, temperature records, and double-mass curves can be used to determine and substantiate both climatological and release effects on downstream water temperatures. Comparison of water-tem-perature records not affected by the reservoir releases with those collected on a stream which is affected, combined with a knowledge of local cli-matological conditions, can be used to estimate the effect of these releases on stream temperatures. Releases from New York City's Cannonsville Reservoir have caused a drop in water temperature of 26F, 8.1 miles downstream, and of 8F, 44.3 miles downstream. Releases from New York City's Pepactor Reservoir have caused a drop of 20F, 31 miles downstream, and 5F, 59.4 miles downstream. (Osborne-Vanderbilt). W70-09171

A KINETIC AND EQUILIBRIUM STUDY OF THE ADSORPTION OF THE ORGANIC INSECTICIDES CARBARYL AND PARATHION UPON SOME SOIL ORGANIC MATTER SURFACES, Purdue Univ., Lafayette, Ind.

J. A. Leenheer.

Purdue University, Doctor of Philosophy Thesis. August, 1970. p 110, 28 fig, 3 tab, 71 ref. OWRR t Project A-005-IND (14).

Descriptors: *Pesticide kinetics, Pesticide adsorption, Carbamate pesticides, *Organic pesticides, Organic matter, Isotherms, *Soil organic matter, Surface adsorption.

Identifiers: Romney silty clay loam, Zanesville silty clay loam, Carlisle muck, Parathion pesticide.

Pesticides are a potential water pollutant. Soil organic matter surfaces adsorbs certain kinds of compounds and render them essentially immobile. The mechanism of pesticide adsorption on soil organic matter is reported in this study. The adsorptive capacities of Carbaryl and parathion upon various organic matter adsorbents were compared by determining adsorption isotherms for aqueous insecticide concentrations ranging up to 6 ppm. For all adsorbents, the adsorptive capacities of parathion were two to three times the adsorptive capacities of carbaryl. Romney soil organic matter with hydrogen on the exchange sites was found to adsorb much more carbaryl and parathion than with calcium on the exchange sites. Water vapor adsorption isotherms showed the hydrogen saturated organic matter to have a much more hydrophobic nature than the calcium saturated organic matter. A similar direct relationship between the hydrophobic nature of the adsorbent surface and the extent of adsorption was found for a carbaryl cation exchange resin with calcium and hydrogen saturation. A non-ionic hydrophobic resin gave very large adsorptive capacities. Differences in the adsorptive capacities between the organic matter adsorbents derived from different soils were relatively slight.

COMPOSITION OF WATER IN CLINCH RIVER, TENNESSEE RIVER, AND WHITEOAK CREEK AS RELATED TO DISPOSAL OF LOW LEVEL RADIOACTIVE LIQUID WASTES, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 05B. W70-09194

A MODIFICATION OF THE BENZENE SYNTHESIS METHOD FOR TRITIUM ANALY-

Florida State Univ., Tallahassee. For primary bibliographic entry see Field 02K. W70-09213

WATERSHED HUMAN-USE LEVEL AND

WATER QUALITY,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

For primary bibliographic entry see Field 05B.

BOD MASS BALANCE AND WATER QUALITY

BOD MASS BALANCE AND WATER COADITA
STANDARDS,
Rutgers - The State Univ., New Brunswick, N.J.
Water Resources Research Inst.
William Whipple, Jr.
Water Resources Research, Vol 6, No 3, p 827837, June 1970. 11 p, 11 fig, 2 tab, 12 ref. Project
p.002 NI

Descriptors: *Water pollution sources, *Water pollution control, *Mathematical models, *Systems analysis, *Sampling, Data collections, Biochemical oxygen demand, Waste disposal, Sewage treatment, New Jersey, Biodegradation, Path of pollutants, Standards, Urbanization.

lentifiers: BOD mass balance, Water quality stan-

o establish appropriate water quality controls, the nagnitude of the gross pollution load of a basin hould be known. Usually it is not. Mathematical nodeling of basinwide BOD relationships can be reatly facilitated by applying known equations on basis of BOD mass loading rather than of BOD oncentration. The necessary hydrologic basis inludes travel time dye tests, data as to slopes and listances, and computation of travel times for all arts of the basin at various stages. Treatment plant and instream BOD records are essential. The basic 30D removal parameter must be computed and djusted for different conditions. The remaining computations require a computer but are not espeially difficult. The principal reservation as to accuacy of the results consists of the allowance that nust be made for nitrogenous BOD. Applications of this method to three New Jersey basins indicate that in each case the recorded BOD data from treatment plants account for less than half of the total pollution loading entering the stream. The policy implication is that it is inappropriate to plan water quality standards and programs of corrective measures on the assumption that recorded effluents constitute the only major source of pollution. (Kmapp-USGS) W70-09349

NITRATE VARIATION IN GROUNDWATER, Wisconsin Univ., Madison. Water Resources

Koby T. Crabtree.

Available from NTIS as PB-193 707, \$3.00 in paper copy, \$0.65 in microfiche. Supplementary Report, (1970). 60 p, 8 tab, 9 fig, 87 ref, append. OWRR B-004-WISC (10).

Descriptors: *Nitrate, *Wells, *Nitrite, *Coliform, Geology, Wisconsin, *Groundwater, Water chemistry, *Water analysis.

The nitrate content of approximately 250 private wells representing 20 townships in Marathon County and several wells from outside the county were investigated. Nitrate, nitrite and coliform contents of some 80 wells from Rib Falls-Rietbrock were monitored twice a month for over a year. Seventy per cent of wells contained nitrate level of greater than 45 mg/l nitrate at one time or another within a period of a year and about 45 per cent of the wells contained excess of 45 mg/l nitrate throughout the year. Nitrate contents usually were highest during the heavy rainy season (April - June). There was no clearly defined relationship between depth of wells and high nitrate content, probably owing to perviousness of soil and existence of extensive fractures and crevices in the bedrock. Similarly, wells from Grade A milk suppliers were analyzed and it was found that 44 per cent of 59 well water samples had nitrate content greater than 45 mg/l. Likewise, nitrate content of 64 wells from nondairy farmers were analyzed and approximately 35 per cent of well water samples contained greater than 45 mg/l nitrate. (See also W70-09426). W70-09425

AN ANALYTICAL METHOD FOR EVALUATING THE SUSCEPTIBILITY OF FISH SPECIES TO AN AGRICULTURAL CHEMICAL (JAPANESE),

Ihara Agricultural Chemicals Inst., Shimizu

Sumio Nagasawa, Shoji Asano, and Kazunobu

English summary. Japanese Journal of Applied Entomology and Zoology, Vol 8, No 2, p 118-122, 1964. 3 ref, 1 tab, 1 fig.

Descriptors: *Regression analysis, *Mathematical studies, *Bioassay, *Test procedures, Mortality, Variability, Analysis, *Evaluation, Water pollution

Identifiers: Body weight, Dojo fish, Goldfish.

If the variance of size of test organisms used in the biological assay experiment of chemicals is large, the dosage applied must be corrected corresponding to their size. 'Size factor' for equalizing individual differences in body weight can be calculated by the multiple regression equation. The survival time after immersion was determined as the function of dosage and body weight. Based on this idea, a comparative test on susceptibility to E1-43,064 between the goldfish and 'Dojo' fish was made by the dipping method. The result has shown that the 'Dojo' fish is 5.32 times as susceptible as the goldfish to E1-43,064. (Sjolseth-Washington) W70-09433

5B. Sources of Pollution

HYDROCHEMICAL REGIME AND SALT BALANCE OF OTKAZNENSKIY RESERVOIR IN THE FIRST YEAR OF ITS EXISTENCE (1966),

Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR). For primary bibliographic entry see Field 02K.

SELF-PURIFICATION OF NATURAL WATERS

FROM CARBOHYDRATES, Nauchno Issledovatelskii Gidrokhimicheskii In-

Nauchno Issiedovateiskii Gidrokhimicheskii institut, Novocherkassk (USSR).
L. G. Shaova, and V. T. Kaplin.
Translated from Hydrochemical Materials
(Gidrohkimicheskiye Materialy), Vol 49, p 166174, 1969. Soviet Hydrology: Selected Papers,
Issue No 2, p 171-177, 1969. 7 p, 8 fig, 10 ref.

Descriptors: *Biodegradation, *Waste assimilative capacity, *Stream flow, *Self-purification, Laboratory tests, Oxidation, Nitrification, Ammonia, Water pollution effects, Path of pollutants, Nutrients, Organic matter.
Identifiers: *Carbohydrate biodegradation, USSR.

A study was made to determine the self-purification in natural waters of pollution by various classes hydrocarbons (monosaccharides polysaccharides): glucose, sorbose and maltose, which may be present in the waste water of the food industry. Decomposition of glucose, sorbose, and maltose depends insignificantly on the initial concentration of the substance and practically terminates on the 4th day. Oxidation of hydrocarbons in natural water under laboratory conditions occurs mainly as a result of biochemical oxidation and is accompanied by a considerable increase in the number of saprophytic microflora (to 100,000/ml) and a decrease in the concentration of oxygen dissolved in the water. Ammonification slows down during the self-purification of water from hydrocar-A slight slowing down of nitrification is observed only at a hydrocarbon concentration exceeding 25 mg/liter. (Knapp-USGS) W70-09100

OXIDATION OF ALCOHOLS AND THEIR IN-FLUENCE ON THE SELF-PURIFICATION OF NATURAL WATERS, Nauchno Issledovatelskii Gidrokhimicheskii In-

stitut, Novocherkassk (USSR); and All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
L. P. Sokolova, and V. T. Kaplin.

L. P. Sokolova, and V. T. Kapini.

Translated from Hydrochemical Materials (Gidrokhimicheskiye Materialy), Vol 49, p 175-182, 1969. Soviet Hydrology: Selected Papers, Issue No 2, p 177-183, 1969. 7 p, 5 fig, 1 tab, 15

Descriptors: *Biodegradation, *Alcohols, *Waste assimilative capacity, *Self-purification, *Streamflow, Laboratory tests, Oxidation, Nitrification, Ammonia, Water pollution effects, Path of pollutants, Nutrients, Oxegorie matter. tants, Nutrients, Organic matter.
Identifiers: *Alcohol biodegradation, USSR.

The kinetics and mechanism of decomposition of individual aliphatic alcohols and aldehydes in natural bodies of water and their effect on natural selfpurification were studied for methyl and ehtyl alcohols and formaldehyde. Study of the decomposition rate of alcohols in natural water with allowance for the dynamics of saprophytic microflora showed that during intense alcohol decomposition the number of colonies increased sharply. Propanol and pentanol show a tendency to slow down the development of the saprophytic microflora to the extent that the number of colonies even decreased in the first day of the experiment. This decrease was followed by increased multiplication of the bacteria. The biochemical oxidation of alcohols is the main and decisive process leading to the decrease in the concentration of alcohols in natural bodies of water. The oxidation of alcohols results in a sharp decrease of the oxygen dissolved in water and this may have a harmful effect on the oxygen regime. The alcohols tested have a significant effect on nitrification and ammonification processes. The content of ammonium ions increases and nitrification is slowed down considerably in the presence of alcohol. (Knapp-USGS) W70-09101

THE PROTECTION OF GROUNDWATER RESOURCES.

National Water Well Association, Columbus, Ohio. For primary bibliographic entry see Field 02F. W70-09127

RESEARCH NEEDS ON THERMAL AND SEDI-MENTARY POLLUTION IN TIDAL WATERS.

American Society of Civil Engineers. Committee on Tidal Hydraulics of the Hydraulics Div.

Journal of the Hydraulics Division, Proceedings of ASCE, Vol. 96, No. HY7, Proc. Paper 7426, July 1970, p1539-1548, 7 ref.

Descriptors: *Thermal pollution, *Sediment discharge, *Tidal waters, Stratification, Estuarine, Environment, Research and development, Sediment transport, Water quality, Hydraulics, Physics, Dispersion, Heat transfer.

Identifiers: *Sedimentary pollution, Hydraulic environment.

When recently requested to identify the most pressing research need in its field, the ASCE Tidal Hydraulics Committee quickly arrived at the concensus opinion that thermal and sedimentary pollution of tidal water bodies was the major problem in need of research in its respective field. The report describes the nature of this problem and includes a review of the literature and some related research. The report outlines general and specific research needs in both thermal and sedimentary pollution and includes a section on instrumentation. It recommended detailed studies as follows: 1. An assessment of sedimentary and thermal pollution problems in selected estuaries of various characteristics. 2. A comprehensive assessment of the state-of-the-art understanding of thermal and sedimentary pollution in tidal waters. (Hsieh-Vanderbilt) W70-09161

HEAT WASTE, Rosenstiel School of Marine and Atmospheric Sciences, Miami, Fla. Bob Stearns.

Sea Frontiers, Vol. 16, No. 3, May-June, 1970, p154-163, 6 fig.

Descriptors: *Heated water, *Nuclear power-plants, *Cooling water, *Tropical regions, *Estuarine environment, Heat flow, Vegetation, Isotherm, Human population, Coasts, Distribution patterns, Cooling towers, Canals.
Identifiers: *Population control, Capital tax.

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources of Pollution

Florida Power and Light Company is constructing a combination conventional (in operation) and nuclear (under construction) electric powerplant at Turkey Point on the southwestern shoreline of Biscayne Bay. This area is of special interest since it is the first nuclear power plant under construction in a tropical or near tropical area. It was observed that temperature at the effluent canal exists averaging 9 deg to 11 deg F above bay ambient and the thermal plume position is persistent. Significant damage of bottom vegetations was observed. Many cooling methods were discussed. Due to the huge size of plant, hurricane force winds and drift problem, no satisfactory cooling method can be achieved. The author suggested that whole population control or population density control should be done before we can solve the problem of increasing power demands. (Hsieh-Vanderbilt) W70-09162

BUOYANT PLUMES AND THERMALS,

Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.

Annual Review of Fluid Mechanics, Vol. 1, p 29-44, 1969, 3 fig, 53 ref.

Descriptors: *Turbulence, *Buoyancy, *Geothermal studies, Convection, Density, Reynolds number, Profiles, Velocity, Clouds, Air circulation, Condensation

Identifiers: *Plume, Entrainment, Similarity argu-

This chapter summarizes the literature covering a variety of phenomena that can be related under the general heading of turbulent buoyant convection from small sources. The studies are generally based on laboratory experiments and therefore the assumption is made that the form of the buoyancy source and the environmental conditions can be specified in advance and that these remain unchanged during the whole time the plume or thermal is being studied. The plumes and thermals are first considered in a uniform environment. For both plumes and thermals, the proportional rate of entrainment depends inversely on the radius. However, the rate of dilution of thermals is much greater than for plumes. It should be noted that no way has been found so far to deal numerically with the sharp boundary between the turbulent buoyant fluid and its surroundings. In an unstable environment, similarity arguments can also be used to exhibit some important features of convection from small sources. Yet, in a stable environment, initial conditions and density distributions are needed for the similarity argument. (Osborne-Vanderbilt)

A KINETIC AND EQUILIBRIUM STUDY OF THE ADSORPTION OF THE ORGANIC INSEC-TICIDES CARBARYL AND PARATHION UPON SOME SOIL ORGANIC MATTER SURFACES, Purdue Univ., Lafayette, Ind.

For primary bibliographic entry see Field 05A

NOTES ON A THEORY OF THE THER-MOCLINE.

Scripps Institution of Oceanography, La Jolla,

Walter H. Munk, and Ernest R. Anderson. Journal of Marine Research, Vol 7, No 3, p 276-295, November 1948. 7 fig, 4 tab, 8 ref.

Descriptors: *Thermocline, *Currents (Water), *Heat flow, *Water temperature, Solar radiation, Convection, Winds, Shear stress, Latitudinal studies, Turbidity, Salinity, Bathythermographs, Statite.

Identifiers: *Eddy viscosity, Eddy conductivity.

In this report, the function for eddy viscosity introduced by Rossby and Montgomery and a newly derived function for eddy conductivity are substituted into the differential equations governing the distributions of temperature and current. The equations are then solved simultaneously. In view of the difficulty experienced in selecting conditions under which heat loss by evaporation is relatively small compared to heat gain by radiation, it would appear that convective stirring is as important as wind stirring in many, and perhaps most, cases. The results of the report indicate: (1) that the sharp transition between the mixed layer and the thermocline can be accounted for theoretically by letting the eddy coefficients be functions of the stability and shear; (2) that the theory gives a thermocline depth which, although too shallow, is of the right order of magnitude; (3) that this depth depends on wind speed, latitude, heat flux, and the temperature salinity correlation, in the order stated; and (4) that the variation with each of these factors occurs in a reasonable direction. (Osborne-Vanderhilt) W70-09191

COMPOSITION OF WATER IN CLINCH RIVER, TENNESSEE RIVER, AND WHITEOAK CREEK AS RELATED TO DISPOSAL OF LOW LEVEL RADIOACTIVE LIQUID WASTES, Geological Survey, Washington, D.C.

For sale by Superintendent of Documents, U S Government Printing Office, Wash, D C - 20402. Price \$0.30. U S Geological Survey Professional Paper 433-J, p J 1 - J 15, 1970. 15 p, 4 fig, 6 tab, 39

Descriptors: *Radioactive waste disposal, *Water pollution sources, *Water pollution effects, *Path of pollutants, Streamflow, Sediments, Adsorption, Absorption, Chemical precipitation, Clay minerals, Calcium carbonate

Identifiers: *Oak Ridge National Laboratory, Tennessee River, Clinch River, Whiteoak Creek.

Radioactive wastes from the Oak Ridge National Laboratory are released to Whiteoak Creek. Samples of water were taken at seven sampling stations during a period of 3 years and composited into weekly or monthly samples according to streamflow. Determinations were made of physical parameters and of the content of stable chemical constituents, radiochemical constituents, and suspended sediment in the composite samples. The water is of the calcium bicarbonate types. Tennes-see River water is similar in composition to Clinch River water and the water of Whiteoak Creek, but contains somewhat less bicarbonate, calcium, magnesium, and suspended and dissolved solids, and somewhat more sodium and chloride. Whiteoak Creek is more highly mineralized than the other two streams, and has more sulfate, nitrate, phosphorus, and sodium. Most of the cesium-137 entering the Clinch River in Whiteoak Creek water was associated with suspended solids. In the Tennessee River, cesium-137 was either dissolved in nessee River, cesium-137 was either dissolved in the water or associated with solids of colloidal or near-colloidal size. Much of the strontium-90 present in Whiteoak Creek water may be associated with precipitated calcium carbonate. Close similarities in variations in concentration between ruthenium-106 and cobalt-60 in both Whiteoak Creek and the Clinch River, and their correlation with aircute segent correlation and correlation was segent correlation at the correlation of the strontium-90 present in whiteoak creek water may be associated with precipitated calcium carbonate. correlation with nitrate reflect their common origin in high-nitrate solutions released to the basin of Whiteoak Creek. (Knapp-USGS) W70-09194

NEW YORK METROPOLITAN REGION--A MAJOR SEDIMENT SOURCE, State Univ. of New York, Stony Brook. Marine

Sciences Research Center. For primary bibliographic entry see Field 02J. W70-09203

DISPERSION IN HOMOGENEOUS ESTUARY

Illinois Univ., Urbana; Massachusetts Inst. of Tech. Cambridge; and California Univ., Berkeley. Dept. of Civil Engineering. For primary bibliographic entry see Field 02L.

W70-09217

STRONTIUM 90 CONCENTRATIONS IN SUL FACE AIR: NORTH AMERICA VERSUS AN LANTIC OCEAN FROM 1966 TO 1969, New York Operations Office (AEC), N.Y. Healt

For primary bibliographic entry see Field 02B. W70-09229

WATERSHED HUMAN-USE LEVEL ANN WATER QUALITY, Taft Sanitary Engineering Center, Ciri

Robert A. Ta Roger D. Lee, James M. Symons, and Gordon G.

Robeck.

Journal American Water Works Association, Vc 62, No 7, p 412-422, July 1970. 11 p, 12 fig, 9 table 18 ref.

Descriptors: *Water quality, *Water supply *Watersheds (Basins), *Pacific Northwest U.S.5 *Watershed management, Surface waters Coliforms, Bioindicators, Water management (Applied), Water policy, Multiple purpose. Identifiers: *Watershed use.

A study was conducted from December 1965 through September 1967 to measure the physicals chemical, and microbiological quality of water flowing from three watersheds in the northwestern part of the United States. These watersheds were those of the Cedar and Green Rivers in Washington, and the Clackamas River in Oregon. The watersheds are similar in environmental factors such as terrain, elevation, forest cover, and meteorological conditions but vary in their human use. The Cedar watershed is well protected; the Green watershed has some resident population and limited recreational use; and the Clackamas watershed is open for unrestricted access and unlimited recreation. By present techniques, no measurable influence could be determined on bacterial indicator population densities because of the in-crease in human use level among the Cedar River, the Green River, and the Clackamas River watersheds. The animal population on all three watersheds was much higher than the human use level and generally similar among watersheds. (K-napp-USGS) W70-09240

LEAD IN A SUBURBAN ENVIRONMENT, For primary bibliographic entry see Field 02K. W70-09251

DISSOLVED SOLIDS-DISCHARGE RELATION-SHIPS: 1. MIXING MODELS, New Hampshire Univ., Durham. For primary bibliographic entry see Field 02K.

POLLUTION OF ESTUARIES, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 05C. W70-09383

DETERGENTS, PHOSPHATES, AND WATER

POLLUTION, Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch. For primary bibliographic entry see Field 05C. W70-09388

A SYSTEM APPROACH FOR THE STUDY AND CONTROL OF FACTORS AFFECTING WATER

W70-09311

CONTROL OF FACTORS AFFECTING WATER POLLUTION,
Mississippi State Univ., State College. Water Resources Research Inst.
Abdel-Razek Abouel-Nour.
Available from NTIS as PB-193 720, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, Water Resources Research Institute, July,

1970. 48 p, 1 tab, 15 fig, 8 ref. OWRR Project A-039-MISS (1).

Descriptors: Water pollution control, Regression analysis, *Systems analysis, Mississippi, Decomposing organic wastes, Biochemical oxygen demand, Dissolved oxygen, *Water quality, Degradation (Decomposition), *Numerical analysis, *Water pollution sources, Computer programs. Identifiers: *Pear River (Miss).

The objectives of the research were directed toward testing the feasibility of applying a system approach for the study of pollutants and/or quality factors in a river. The Pearl River and its major tributaries were selected to implement the study. Quality data of the research areas were supplied by Air and Water Pollution Control Commission, Jackson, Mississippi. Preliminary analysis of the Pearl River data suggested treating it by dividing it into reaches. For example, the regression equations of the biochemical oxygen demand (BOD), and dissolved oxygen (DO) for two consecutive reaches (one of them is heavily polluted) underestimate the ultimate degradation in qualities near the significant organic waste source. Seven reaches have been used for the Pearl River and its major tributaries. Stepwise multiple regression FORTRAN program has been compiled and run under an IBM 360 system for regressing the quality factors of each reach. The quality characteristics of the surface waters have been mathematically explained. Five sets of regression equations, each describing the qualities of water in one reach during short and dry periods, were obtained. Another two sets of regression equations describing the qualities of water in the river at the city of Bogalusa, Louisiana, one set for the year 1967 and the other for the year 1968, were also obtained. Within limitations imposed by the data, the regression equations can be used for purposes of prediction. Application of the regression equations to include two consecutive reaches failed in statistical tests. W70-09422

THE EFFECT OF SALINITY ON THE OXIDATION OF HYDROCARBONS IN ESTUARINE ENVIRONMENTS, Mississippi State Univ., State College. Water

Resources Research Inst.

L. R. Brown, W. E. Phillips, Jr., and J. M.

Tennyson. Available from NTIS as PB-193 706, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, Water Resources Research Institute, July, 1970. 28 p. 2 tab, 10 fig, 5 ref, append. OWRR Project A-034-MISS (1).

Descriptors: Microbiology, Oil, *Oily water, *Oxidation, *Hydrocarbons, *Salinity, Estuarine environment, *Degradation (Decomposition), Water pollution sources

Identifiers: Petroleum degradation.

The physical changes observable during the microbial degradation of refined motor oil under conditions of varying salinity indicated a more rapid degradation in samples inoculated with bottom deposits than did those containing just the overlying seawater. These changes were comparable to those observed in previously conducted fresh water studies. The rate of oxygen consumption during the microbial degradation of naphthenic crude oil and refined motor oil at various salinities indicated that more rapid degradation occurred in samples with salinities ranging from 17-34 parts per 1000. In all probability these results could be attributed to the fact that the inocula were derived from bottom samples with overlying waters having salinities in these ranges, confirming previous stu-dies which indicated that the origin of the inoculum had a significant effect on the rate of decomposition. It was concluded that while each individual petroleum product will be degraded at a different rate, rates at different salinities will be comparable if the inocula employed in the studies are derived from that salinity. Predominant types of bacteria occurring at different salinities have been isolated

and changes in the bacterial population which occurred during microbial degradation have been noted and representative species isolated and identified. The naphthenic crude oil appeared to be a more selective substrate since only one genus (Pseudomonas) predominated at the end of incubation, whereas three (3) or more microbial types were evident at the termination of the experiment employing refined motor oil. A number of investigators have asked the question as to whether or not the anaerobic decomposition of hydrocarbons does occur. While the results reported in this investigation do not answer the question, it can be said that under the conditions employed anaerobic decomposition of hydrocarbons appears to have taken place. The presence of water-isoluble, petroleum ether-insoluble materials in the 'oil layer' was shown as well as the production of appreciable amounts of hydrogen sulfide. W70-09424

A STUDY OF FARM WASTE, FARM ANIMAL WASTE: CHARACTERIZATION, HANDLING, UTILIZATION,

Wisconsin Univ., Madison.
S. A. Witzel, O. J. Attoe, E. McCoy, L. B.
Polkowski, and K. Crabtree.
Available from NTIS as PB-193 708, \$3.00 in paper copy, \$0.65 in microfiche. Supplementary Report, (1970). 141 p, 6 ref, 4 append. OWRR Project B-004-WISC (11).

Descriptors: *Animal wastes, *Waste storage, *Aerobic treatment, *Anaerobic digestion, Surface runoff, Fertilizer, Sewage bacteria, Percolation, Lagooning, Wisconsin. Identifiers: *Bovine waste, *Groundwater pollu-

tion. Fertilizer effectiveness.

The farm animal waste problem in Wisconsin is multifaceted. Not only are there the usual aspects like kinds of animal manures, differences in farming practices (including size of herds, feeds and manner of feeding) but also there are problems because of the geographic location of the state. Its long cold winters enforce at least a consideration of 4-6 months of storage to avoid spreading of manure on frozen ground. Secondly, its glaciated soils present locally different bedrock and soil permeability. In the southern half of the state where both farming and population are concentrated, the waters are hard and fractured limestone formations underlie much of the area. Attention is now being called to the possible pollution of groundwater. And lastly, Wisconsin is a state of lakes and streams, many of which are undergoing critical eutrophication. Farm manure and fertilizer are being blamed at least in part, and thus surface water run-off, enriched by manure spread on hilly land, is a special problem. (See also W70-09425). W70-09426

GIBSON V CITY OF TAMPA (POLLUTION OF OYSTER BEDS BY UNTREATED MUNICIPAL SEWAGE).

185 So 319-321 (Fla 1938).

Descriptors: *Florida, *Sewage effluents, *Water pollution effects, *Oysters, Leases, Water rights, Pollutants, Municipal wastes, Waste treatment, Sewage disposal, Cities, Bays, Oceans, Water pollu-Sewage disposal, Cities, Bays, Oceans, Water pollution, Sewage, Public health, Water law, Public rights, Local governments, Legislation, Legal aspects, Judicial decisions, Eminent domain, Conditional Conference of the Conference demnation, Relative rights.
Identifiers: *Oyster contamination.

Plaintiffs held leases from the state authorizing them to cultivate oysters in Hillsborough Bay, and had built up a valuable oyster business. Plaintiffs brought action against defendant city for damages resulting from the city's practice of dumping raw, resulting from the city's practice of damping taw, untreated sewage into the bay thereby contaminating plaintiffs' oysters, the sale of which was prohibited by defendant city's public health officials. Plaintiffs contended that state law protected

their investment in the oyster bed leases. Defendant relied upon the common law right of a municipality to empty its sewage into the sea. The court held that state statutes providing for the propagation and cultivation of oysters, and important industry in Florida, materially altered defendant's common law sewage disposal rights. The court also found that plaintiffs' oyster leases were valuable property rights and could not be taken or damaged without compensation, and remanded the case for a determination of damages. (Liptak-Florida) W70-09485

AGRICULTURAL WASTES AND THE EN-VIRONMENT,

Ohio State Univ., Columbus. Dept. of Agricultural Engineering.

E. Paul Taiganides. Agricultural Engineering, Vol 51, No 6, p 358-359,

Descriptors: *Farm wastes, Water pollution sources, Effects, Irrigation effects, Insecticides,

Agricultural wastes contribute fifty percent of the sediment load in rivers in the United States. Animal wastes, crop residues, in addition to insecticides, fertilizers, waste waters from agrochemical processing plants make up these polluting agricultural wastes. The author contends that recycling these wastes into the production system' is the only effective way to manage these wastes. (Holmes-Rutgers) W70-09498

5C. Effects of Pollution

FACTORS AFFECTING THE MOVEMENT OF WATER AND ORGANISMS WITHIN A REGU-

LATED MULTIPURPOSE LAKE, Washington State Water Research Center, Pull-

For primary bibliographic entry see Field 02H.

WATER QUALITY IN RELATION TO PRODUCTIVITY OF LAKE ASHTABULA RESERVOIR IN SOUTHEASTERN NORTH DAKOTA,

North Dakota Water Resources Research Inst., Fargo.

John J. Peterka.

Available from NTIS as PB-193 683, \$3.00 in paper copy, \$0.65 in microfiche. Research Project Technical Completion Report, WI-221-002-69, March 1969. 23 p., 4 tab, 7 fig, 18 ref. OWRR Project A-004-NDAK (1).

Descriptors: Reservoir, *Primary productivity, *Eutrophication, Water quality, *Nutrients, Limnology, Water temperature, *Algae blooms, Cyanophyta, North Dakota. Identifiers: Lake Ashtabula.

This study attempts to relate the chemical and physical characteristics of the lake water to standing crops and production rates of phytoplankton. The average gross photosynthesis rate was 41 percent of the optimal rate. PHYTOPLANKTON STANDING CROPS AVERAGED <\$ UG CHLOROPHYLL/LITER IN THE EUPHOTIC ZONE. Optimal photosynthesis per unit. chlorophyll averaged 13.5 mg 02/mg chlorophyll/hour. Gross production per unit chlorophyll decreased with increase in phytoplankton standing crop. Annual gross photosynthesis was 1.4 gC/m2/day. Three empirical equations were used to predict photosynthesis in the euphotic zone. Gross photosynthesis was related to standing crop and water temperature, but not to CO2 or macro-nutrients. High nutrient levels and continual circulation of the water during ice-free periods made the lake eutrophic. (Peterka-North Dakota

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C-Effects of Pollution

W70-09093

SELF-PURIFICATION OF NATURAL WATERS FROM CARBOHYDRATES, Nauchno Issledovatelskii Gidrokhimicheskii In-

stitut, Novocherkassk (USSR). For primary bibliographic entry see Field 05B.

OXIDATION OF ALCOHOLS AND THEIR IN-FLUENCE ON THE SELF-PURIFICATION OF NATURAL WATERS,

Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR); and All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 05B.
W70-09101

THE TEMPERATURE SELECTION OF SMALL HYPOPHYSECTOMIZED GOLDFISH, (Carassius auratus L.).

Queen's Univ., Kingston (Ontario). Dept. of Biolo-

gy. A. W. Roy, and P. H. Johansen. Canadian Journal of Zoology, Vol 48, No 2, March 1970, p 323-326, 1 fig, 1 tab, 15 ref.

Descriptors: *Water temperature, *Physiological ecology, *Fish, *Fish physiology, Bioassay, Temperature control.

Identifiers: *Temperature selection, *Horizontal temperature gradient, Goldfish, Pituitary hormones, Hypophysectomy, Nervous system.

The selected temperature ranges of unoperated, sham-operated, and hypophysectomized goldfish were determined in the horizontal temperature gradient. Hypophysectomy did not alter the selected temperature of small goldfish. Three hypotheses can be offered to explain the results. The simplest is that the pituitary is not essential for the maintenance of the temperature selection response by goldfish. The second hypothesis is that neurohypophysis may be involved, since there is evidence that, in at least some hypophysectomized goldfish, a seemingly homologous structure is the hypophyseal area has been found by Sathyanesan and Gorbman. The third is that a balance of pituitary hormones influences the nervous system so that the response is changed with the season as well as acclimatization temperature, and that once the change has been effected, the hormones play no further role and hence their absence has no influence. The last hypothesis could be tested by further work. (Hsieh-Vanderbilt)
W70-09151

TEMPERATURE-DEPENDENT CHARACTERISTICS OF PERIPHERAL NERVES EXPOSED TO DIFFERENT THERMAL CONDITIONS IN THE SAME ANIMAL, Institute of Arctic Biology, Alaska University, Col-

lege, Alaska. L. Keith Miller.

Canadian Journal of Zoology, Vol. 48, No. 1, Jan. 1970, p75-81, 5 fig, 3 tab, 10 ref.

Descriptors: *Cold resistance, *Beavers, *Tem-

perature, Conduction. Identifiers: *Nerves, *Peripheral nerves, Caudal nerves, Phrenic nerves, Tibial nerves, Excitability, Refractory period, Action potential characteristics,

Beaver (Castor canadensis) caudal nerves, accustomed to tissue temperatures approaching 0 deg customed to tissue temperatures approaching 0 deg C, were compared with nerves that encounter less severe cooling (Tibial), and nerves that are accustomed only to deep body temperature (phrenic). Caudal nerves invariably conducted action potentials until freezing at about -5 deg C. Tibial nerves ceased conducting at 0 deg C and phrenic nerves failed at 4.5 deg C. Conduction velocity-temperature slopes of the three nerves were different and absolute refractory periods in the cold-adapted nerves were significantly shorter at low temperature. Results furnish additional proof of cold adaptation in peripheral nerve. (Hsieh-Vanderbilt) W70-09160

EFFECTS OF THERMAL DISCHARGE FROM THE SAN ONOFRE NUCLEAR GENERATING STATION,

Southern California Edison Co., Los Angeles. Dept. of Mechanical Engineering.

J. N. Reeves. Proceedings of the Industrial Waste Conference, 23d, Typescript 19 p.

Descriptors: *Thermal pollution, *Nuclear powerplants, *Cooling water, *Oceanography, *Marine fisheries, *Marine plants, *Monitoring, *On-site investigation, Aquatic environment, Outlets, Seashores, Water quality, Temperature, Isotherms, Dissolved oxygen, Bottom sediments, Turbulence, Hydrogen ion concentration.

Identifiers: Kelp, Distribution of kelp beds, Marine biology.

The purpose of this oceanographic monitoring program are to quantitatively and qualitatively describe features of the ocean environment prior to San Onofre plant operation and to evaluate effects which the plant might have on the marine biological community after plant operation begins. The study includes biological observations at five stations along the beach, monitoring the benthic biology at six diving stations offshore and various water quality parameters such as pH, temperature, dissolved oxygen, turbidity, and bottom sediments at 32 hydrographic stations. This report concludes that no significant adverse effects on the general marine environment have been observed which can be associated with the operation of the San Onofre Station which uses 350,000 GPM cooling water. The author believes that this study has demonstrated that the San Onofre plant is compatible with its environment and that the beneficial uses of the marine adjacent to the plant site are being fully protected. (Hsieh-Vanderbilt) W70-09165

EFFECT OF TEMPERATURE AND SALINITY ON THE HEAT TOLERANCE IN THE HERMIT CRAB, DIOGENES BICRISTIMANUS, Marathwada Univ., Aurangabad (India). Dept. of

R. Nagabhushanam, and R. Sarojini. Hydrobiologia, Vol. 34, Fasc. 2, Nov. 1969, p 126-134, 10 fig, 12 ref.

Descriptors: *Temperature, *Salinity, *Bioassay, *Heat resistance, Crabs, Invertebrates, Acclimatization, Lethal limits, Tidal effect. Identifiers: *Diogenes bicristimanus, Hermit crab.

The influence of laboratory acclimatization to various temperature-salinity combinations on the heat tolerance of the hermit crab, Diogenes tolerance of the hermit crab, Diogenes bicristimanus, was determined. In experiment 1, the temperature of 50% survival in (1) base line (35 deg C and 30% salinity), and acclimatized at (2) 35 deg C and 30%, (3) 35 deg C and 5%, (4) 22 deg C and 30%, (5) 22 deg C and 5% were 38.3 deg C, 45.1 deg C, 40.4 deg C, 32.7 deg C, and 31.5 deg C, respectively. In experiment II, the temperatures of 50% survival in (1) base line (22 deg C and 5%), and acclimatized at the same combinations as in exand acclimatized at the same combinations as in experiment II. (2), (3), (4), and (5) were 27.0 deg C, 38.2 deg C, 37.4 deg C, 30.8 deg C, and 29.05 deg C respectively. It was concluded that acclimatization to a high temperature generally increased resistance to lethal temperature, whereas acclimatization to low salinity generally decreased it. High temperature and high salinity was the most favorable acclimatization combination to withstand the high test temperature. Gain in heat tolerance whether the salinity was low or high, was rapid. (Hsieh-Vanderbilt) W70-09166

TEMPERATURE, REPRODUCTION BEHAVIOR,

Battelle Memorial Inst., Richland, Wash. Charles C. Coutant.

Chesapeake Science, Vol. 10, No. 3 and 4, p 26 is 274, Sept-Dec, 1969, 15 fig, 2 tab, 2 ref.

ANN

Descriptors: *Salmon, *Thermal pollution, *Fisi-reproduction, *Fish behavior, Nuclear reactors Fishing, Trout, Periphyton, Fish eggs, Water temperature, Columbia River, Spawning, Fish migrar tion, Predation, Tagging.

Current research being conducted on salmonial fishes at the Hanford nuclear complex on the Columbia River is discussed. Studies of thermal effective for the salmonial field of the sal fects on reproduction are concerned with two questions. Will the locally spawning fall race on chinook salmon continue to spawn in river areas affected by thermal discharges and will eggs spawned in warmed water have abnormal rates of mortality and growth. In answering these questions, a 202 year, annual census of spawning chinook salmon year, annual census of spawning chinook salmom near reactor discharges and laboratory experiments on incubation and rearing success at elevated temperatures were undertaken. The results showed that a slight temperature rise of only 4 deg F gives a mortality rate that is still permissible, however, greater temperature rises often create mortality rates that are too great. Nevertheless, the higher temperatures help develop a larger size of young salmon which are more canable of notesting them. salmon which are more capable of protecting themselves against their natural enemies. Currently, investigations concerning the affected behavior of salmonids are underway. Major emphasis is on the problem of loss of equilibrium, changes in susceptibility to predation, and changes in migration paths of adult chinook salmon. (Osborne-Vanderbilt)

RESERVOIR EFFECT ON DOWNSTREAM WATER TEMPERATURES IN THE UPPER DELAWARE RIVER BASIN,

Delaware River Basin Commission, Trenton, N.J. For primary bibliographic entry see Field 05A. W70-09171

THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN CONCENTRATION IN THE DELAWARE RIVER,

Drexel Univ., Philadelphia, Pa. Dept. of Civil Engineering. William L. Zemaitis, and Geraldine V. Cox

Prepared for the City of Philadelphia Water Department. Drexel University, Department of Civil Engineering, Philadelphia, July 1970. 13 p, 10 fig, 6 tab, 131 ref. Work No. P-244, Contract No. 88-2239

Descriptors: *Sludge worms, *Dissolved oxygen, *Eutrophication, *Biochemical oxygen demand, *Chemical oxygen demand, *Chemical oxygen demand, *Water pollution sources, *Water pollution effects, *Organic matter, *Oxygen sag, *Impaired water quality, *Estuaries, *Delaware River, Vegetation effects, Sludge, River beds, Algae, Mathematical models. Identifiers: *Delaware Estuary, *Biological life, *Dissolved oxygen concentration.

Describes an investigation of the effects of biological life on the dissolved oxygen content in the Delaware Estuary. Biological, chemical, and physical tests were conducted for eighteen months. Benthal surveys revealed that urbificids (aquatic Benthal surveys revealed that turbificids (aquatic worms), algae, rooted aquatics, and terrestrial vegetation were present. The turbificids were predominant invertebrate species in the sludge deposits, and the population was great where the sediment contained large amounts of organic compounds. Respiration of mixed communities of invertebrates was determined to be selected to the sediment of the vertebrates was determined to be as high as 4.2 verterates was determined to be as high as 4.2 mg/l of oxygen per gram of turbificids. One dead gram of dead turbificids was found to create a BOD5 of 200 mg/l. Toxic pollution, with a resulting total kill of turbificids in a region, could cause a 20,000 mg/l/m2 BOD5. The BOD/COD ratio increases represent a very significant secondary pollution of the estuary. A significant amount of natural ral organics in the form of algae and other vegetation was found. Settlement of these organics in slower moving waters causes enrichment of the sediment and produces a dissolved oxygen sag below Trenton during high flow periods when bottom scouring takes place. Macrofauna metabolism and algae oxygenation and deoxygenation were not incorporated into mathematical models (developed by others) for the Delaware Estuary. The authors state that the waste allocations determined from these models might have differed greatly if all parameters had been considered. Recommendations for further studies are given. (Poertner)

DAVIS V CITIES SERVICE OIL CO (LIABILITY FOR DAMAGES CAUSED BY OIL POLLU-

For primary bibliographic entry see Field 06E. W70-09243

A STATEMENT ON PHOSPHORUS,

Minnesota Univ., Minneapolis. For primary bibliographic entry see Field 05D. W70-09325

ENVIRONMENTAL CHANGES PRODUCED BY COLD-WATER OUTLETS FROM THREE AR-KANSAS RESERVOIRS,

Arkansas Univ., Fayetteville. Water Resources Research Center

For primary bibliographic entry see Field 06G. W70-09344

POLLUTION OF ESTUARIES,

Geological Survey, Washington, D.C. R. L. Cory, and J. W. Nauman. Marine Pollution Bulletin, Vol 1 (NS), No 6, p 87-91, June 1970. 5 p, 2 fig, 3 tab, 3 ref.

Descriptors: *Water pollution effects, *Productivity, *Estuaries, *Thermal pollution, *Maryland, Eutrophication, Nutrients, Thermal powerplants, Heated water, Animals, Environmental effects. Identifiers: Patuxent Estuary (Md).

The biological effects of industrial effluent discharged into a number of estuaries on the US Atlantic seaboard were examined during the past 7 years. The consequences of discharging hot water from a power station and pulp mill effluent on the epifauna of the estuaries of the North Newport and Patuxent rivers, are discussed. The production of dry weight by the epifauna during 1967 was 2.8 times greater in the power station effluent than in the intake canals. There was also an increase in the numbers of barnacles and hydroids in the effluent canal as well as an extension of settlement; that is, they settled earlier in the spring and later in the fall. Outside the confines of the discharge canal of the power station there was a significant increase in epifaunal production at two stations: one upstream and one downstream from the point of discharge.
Both stations produced more dry weight than the uppermost station. The change to highest production is the vicinity of the request station in the vicinity of the request station is the result. tion in the vicinity of the power station is the result of a combination of increased temperatures, downriver shift of high production waters and an increase in the numbers of attaching larvae. There was also downriver change in species composition and a decrease in species diversity. (Knapp-USGS) W70-09383

DETERGENTS, PHOSPHATES, AND WATER

POLLUTION,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.

P. D. Goulden, W. J. Traversy, and G. Kerr.
Canada Department of Energy, Mines and
Resources Inland Waters Branch Technical Bulletin No 22, 1970. 8 p.

Descriptors: *Water pollution effects, *Phosphates, *Nitrates, *Nutrients, *Eutrophica-Descriptors:

tion, Algae, Surfactants, Water pollution sources, Surface waters, Water pollution, Domestic wastes, Municipal wastes. Identifiers: Canada.

This report was prepared to provide the general public with technical information on detergents and the effects of phosphates on the water environment. It answers some of the more commonlyasked questions regarding phosphate-based detergents--what they are, what they contain, how they work and how they affect the quality of our water resources. The property of biodegradability as it applies to detergents is explained. While phosphates and nitrates do not in themselves pose any threat to health at the concentrations involved after diffusion in receiving waters, they do possess nutritive properties which encourage the excessive growth of algae and other forms of undesirable aquatic vegetation. When large amounts of this vegetation decompose at the end of the growing period, depletion of the vital life-sustaining dissolved oxygen in water occurs. This form of pollution, which is caused by excess nutrient enrichment, is also referred to as eutrophication and in its extreme form results in the accelerated aging or dying of lakes. (Knapp-USGS)
W70-09388

RELATION BETWEEN THE 'ITAI-ITAI' DIS-EASE AND THE POLLUTION OF RIVER WATER BY CADMIUM FROM A MINE, Okayama Univ. (Japan). Ohara Inst.

J. Kobayashi.

Presented at the 5th International Water Pollution Research Conference, held in San Francisco, July -August, 1970. 7 p, 2 ref, 3 tab, 6 fig. U.S.P.H.S. Grant WP-00359.

Descriptors: *Public health, *Heavy metals, *Water pollution sources, *Water pollution effects, *Water pollution sources, *Water pollution effects, *Mine drainage, Mine water, Waste water (Pollution), On-site investigations, Calcium, Human diseases, Bioassay, Toxicity, Poisons. Identifiers: *Cadmium, Jintsu River (Japan), *ItaiItai disease, Zinc, Lead, Agricultural damage, *Calcium metabolism.

As a consequence of the discovery of a high content of x Cd, Zn, and Pb in the tissues of the patients suffering from itai-itai disease in a restricted district along the Jintsu River in Japan, there was a strong presumption that the cause of the disease was chronic poisoning by heavy metals found in the waste water from a mine. The following observations were made: (1) Itai-itai disease and damage to rice plants by the waste water appeared in the same place along the banks of the river and decreased at the same time. (2) A heavy accumulation of Cd and other metals was found in the patients' bones, internal organs, soil, and plants. (3) In a laboratory experiment the group of rats which was fed Cd excreted more Ca than that assimilated from the feed, while the control group showed the contrary phenomenon. Thus, the loss of mineral com-ponents from the bones was ascertained to be caused by Cd. From these results, it was made clear that the itai-itai disease was induced by cadmium in the waste water from a mine. (Sjolseth-Washington) W70-09427

EFFECTS OF SUBLETHAL DDT ON A SIMPLE REFLEX IN BROOK TROUT, Fisheries Research Board of Canada, St. Andrews

(New Brunswick).

(New Brunswick). J. M. Anderson, and H. B. Prins. Journal of the Fisheries Research Board of Canada, Vol 27, p 331-334, 1970.

Descriptors: *DDT, Pesticide toxicity, Brook trout, Water pollution effects, *Fish behavior, *Fish physiology, Laboratory tests, Laboratory equipment, Persistence.

Identifiers: Central nervous system, *Conditioned response, Learning, Simple reflex.

Brook trout were conditioned in about 30 trials to exhibit the propeller-tail reflex, with electric shock as the unconditioned stimulus and light as the conditioning stimulus. When the trout were exposed for 24 hr to sublethal DDT (20 ppb), more than half could not be conditioned at all; the remainder required significantly more trials than did the untreated ones. Three to four weeks after initial testing, the DDT effect had largely disappeared. It seemed likely that the DDT WAS ACTING UPON CENTRAL NERVOUS SYSTEM STRUCTURES. The general ecological implications of the results are discussed. (Sjolseth-Washington) W70-09428

TOXICITY STUDIES WITH AN OIL-SPILL EMULSIFIER AND THE GREEN ALGA PRASINOCLADUS MARINUS,

University Coll. of Wales, Aberystwyth. Dept. of Botany.

A. D. Boney

Journal of the Marine Biological Association of the United Kingdom, (1970), p 461-473. 14 ref, 4 tab,

Descriptors: Bioassay, Toxicity, *Emulsifiers, Detergents, Oil, *Oil wastes, Oily water, Oil-water interfaces, Water pollution treatment, Water pollution effects, Environmental effects, Algal poisoning, Algae, Solvents, Surfactants, Water temperature, Plant pigments, Plant physiology, *Plant pathology, Plant growth regulators, Salinity, Plant populations. Identifiers: *BP 1002, *Green algae, Prasinocladus

marinus, Temperature effects.

Cyst phases of the green alga Prasinocladus marinus have been used in an investigation of the toxic properties of an oil-spill emulsifier BP 1002, and of its solvent and surfactant fractions. Various aspects of a rejuvenation process have all been utilized as a means of assay in addition to observations on cell viability. The 'aged' cysts were more tolerant of all types of toxic agents than were the young non-motile cells. The surfactant fractions were more toxic when used alone, and the solvent fraction alone more toxic than the compounded BP 1002. The application of any of the toxic agents at low temperature (4 deg. C) resulted in a marked reduction in their effects at high concentrations (e.g. 500 ppm). The toxic effect was appreciably increased with both 'aged' and 'young' cells when accompanied by a lowering in salinity. Aeration of the toxic solutions caused a significant lowering of toxicity with both BP 1002 and the solvent fraction. Chloroplast pigment regeneration in 'recovering' cysts was a sensitive means of assaying toxic effects. (Sjolseth-Washington) W70-09429

AMMONIA TOXICITY IN SELECTED FISHES,

Missouri Univ., Columbia. Dept. of Agricultural Chemistry.

R. P. Wilson, R. O. Anderson, and R. A.

Bloomfield.

Comparative Biochemistry and Physiology, Vol 28, p 107-118, 1969. 30 ref, 5 fig.

Descriptors: *Ammonia, Bioassay, *Toxicity, Lethal limit, Ammonium compounds, Rainbow trout, Channel catfish, Resistance, Water temperature, *Fish physiology, Laboratory tests, Enzymes, Biochemistry, Environmental effects, Water pollu-

Identifiers: *Ammonium acetate, Goldfish, Ammonotelic fish, Uricotelic fish, Ureotelic fish, *Ammonia toxicity, LD50.

Intraperitoneal LD50 and LD99.9 values for ammonium acetate were determined in three species of ammonotelic fishes; rainbow trout (Salmo gairdnerii), channel catfish (Ictalurus punctatus) and goldfish (Carassius auratus). There was a direct relationship between the LD50 values for ammonium acetate and the relative resistance to environmental conditions, i.e., the trout were the most sensitive, the channel catfish intermediate and the

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

goldfish quite resistant. An increase in aquarium temperature considerably decreased the fishes tolerance to the injected ammonium acetate. Fishes being ammonotelic were found to be more tolerant to the intraperitoneally administered ammonium acetate than either the ureotelic or uricotelic species. Several factors which may contribute to the higher tolerance of exogenous ammonia in the fishes are discussed. (Sjolseth-Washington) W70-09430

EFFECTS OF DIQUAT ON BLUEGILLS AND

THEIR FOOD ORGANISMS, Bureau of Sport Fisheries and Wildlife, La Crosse, Wis. Fish Control Lab.

Philip A. Gilderhus.

The Progressive Fish-Culturist, Vol 29, No 2, April 1967. p 67-74, 11 ref, 5 tab.

Descriptors: *Diquat, *Sunfishes, Toxicity, Herbicides, Fish physiology, Growth rates, *Fish Food organisms, Aquatic weed control, Water pollution effects, Persistence, Bottom sediments, Spawning, Zooplankton, Daphnia.

Identifiers: Cladocera, *Spawning success, *Diquat residues.

Diquat appeared to be nonhazardous to bluegills in moderately hard water. The fingerlings did not appear to be effected in any way by the herbicide. Hematological and histopathological examinations of adult fish failed to reveal any effect of the chemical. The differences in growth rates of adults from pool to pool appeared to be a function of survival and total weight of fish in the pools, and could not be related to concentration of the chemical. The herbicide showed an acute toxicity to cladocera. In most of the pools, however, the populations of cladocera built up to normal levels after the diquat had disappeared from the water. (Sjolseth-Washington) W70-09431

COMPARATIVE STUDIES OF THE MOL-LUSCICIDAL EFFECT OF CUPROUS CHLORIDE AND COPPER SULFATE IN IRAN, **CUPROUS** World Health Organization, Alexandria (Egypt).

K. Y. Chu, J. Massoud, and F. Arfaa. Bulletin World Health Organization, Vol 39, No 2, p 320-326, 1968, 12 ref, 6 tab.

Descriptors: *Copper sulfate, *Molluscacides, *Evaluation, *Snails, Chemcontrol, Piscicides, Toxicity, Mortality, Fishkill, On-site investigations, Copper compounds, Lethal limit, Bioassay, Water pollution effects.

Identifiers: *Cuprous chloride, Iran, *Bulinus trun-

The molluscicidal effectiveness of CuCl was compared to that of CuSO4. In the laboratory in the absence of mud, the compounds were equally effective against Bulinus truncatus in the range 2-32 ppm. using 1-or 13-day-old solutions, but CuCl was more lethal in 43- or 91-day-old solutions. When the experiment was repeated in the presence of mud, CuSO4 was more effective initially (25-400 ppm.). Both, however, rapidly lost their effectiveness when mud was present, and the initial concentrations required were too high to use the compounds effectively for their residual activity. The compounds were then tried on some ponds. For both, 30 ppm. killed and snails immediately, but 9 days later there was no residual activity in the ponds. CuCl at 10 ppm. was as piscicidal as CuSO4, with all fish dying within 96 hrs. Since both compounds are piscicidal as well as molluscicidal, neither is recommended under the field conditions used. (Sjolseth-Washington) W70-09432

AN ANALYTICAL METHOD FOR EVALUAT-ING THE SUSCEPTIBILITY OF FISH SPECIES

AGRICULTURAL CHEMICAL AN (JAPANESE).

Ihara Agricultural Chemicals Inst., Shimizu (Japan).

For primary bibliographic entry see Field 05A. W70-09433

PRELIMINARY RESULTS OF THE EXPERI-MENTS ON THE TOXICITY OF OIL COUNTERACTING AGENT (ESSO COREXIT 7664), WITH AND WITHOUT IRAQ CRUDE OIL, FOR SELECTED MEMBERS OF MARINE PLANK-TON,

Institut fuer Fischerei, Hamburg (West Germany). S. A. Latiff.

Archiv fuer Fischereiwissenschaft, Vol 20, Nos 2/3, p 182-185, 1969. 3 ref, 2 tab.

Descriptors: *Bioassay, Oily water, *Oil wastes, Oil-water interfaces, Water pollution effects, Water pollution sources, *Toxicity, *Emulsifiers, Oil, Water pollution treatment, Crustaceans, *Zooplankton, Lethal limit. Identifiers: *Esso corexit 7664, *Crude oil, *Marine plankton, Pleurobrachia pileus, Coelenterates, Polychaetes, Oil-ex, Anti-oil TS 5, Sillarit, Moltoklar, Peroklean, Slix, Elimax, Gamlen.

Corexit was less toxic than Oil-Ex, Anti-Oil TS 5, Sillarit, Vecom B 24, Struktol J 502, PS 777, Gamlen, Elimax, Slix, Peroklean and Moltoklar (other oil counteracting agents). The addition of crude oil as in the case of Sillarit or Struktol J 502 reinforced the toxicity of Corexit. The lethal limits of corexit for P. pileus, spionid larvae and young Crangon crangon without Iraq crude oil were 0.667, 0.889 and 1.600 ml/1 sea water respectively; the corresponding figures after the addition of crude oil were brought down to 0.222, 0.222 and 0.364 ml/1 ea water respectively. (Sjolseth-Washington) W70-09434

TOXICITY OF SELECTED HERBICIDES TO BLUEGILL SUNFISH,

Louisiana Wild Life and Fisheries Commission. Janice S. Hughes, and James T. Davis.
Proceedings of the Louisiana Academy of
Sciences, Vol XXV, p 86-93, 1962. 10 ref, 2 tab.

Descriptors: *Bioassay, *Toxicity, Fishkill, *Sunfishes, *Herbicides, Aminotriazole, 2-4-D, Dalapon, 2-6-Dichlobenil, Diquat, Aquatic seed control, Water pollution effects, Carbamate pesticides, Lethal limit.

Identifiers: Endothal, Diphenamid, Emid, Fenac, Sterox, CIPC, *TLm, Stull invert oil.

Bioassays were conducted to determine the toxicity of 14 herbicides to bluegill sunfish. 24 and 48 hour TLm's were calculated for endothal, TD-191, TD-47, TD-266, diphenamid, emid, fenac, dichlobenil, CIPC, dalapon, diquat, amitrole, sterox and stull invert oil. (Sjolseth-Washington) W70-09435

EFFECT OF TEMPERATURE SHOCK ON THE TEMPERATURE RESISTANCE OF POIKILOTHERM AQUATIC ANIMALS, EXPERIMENTS ON THE PROBLEM OF HEAT AND COLD-HARDENING IN ANIMALS (GER-MAN), Kiel Univ. (West Germany).

Thies Basedow.

English summary. Internationale Revue der Gesamten Hydrobiologie, Vol 54, No 5, p 765-789, 1969. 64 ref, 15 tab, 16 fig.

Descriptors: *Thermal stress, Environmental effects, *Resistance, Laboratory tests, *Acclimatiza-tion, Water pollution effects, Fish behavior, *Fish physiology, *Cold resistance, Water, *Heat resistance, Heat treatment, Eels, Mollusks, Invertebrates

Identifiers: *Temperature effects, Temperature resistance, *Adaptation.

After a sublethal heat shock the heat resistance of the fishes Idus idus and Xiphophorus helleri and the newt Triturus vulgaris undergoes a slight but statistically significant increase for a short time.
The heat resistance of IDUS idus equally rises after more moderate, but longer lasting heat shocks. After a shock-transfer and maintenance in extremely high temperatures the three fish-species examined do not show a 'heat-hardening' discernible from the heat-adaptation. Sublethal heat shock and shock-transfer in extremely high temperatures have the same effect on the heat resistance of Idus idus. In the biological range of temperature of Idus idus and Anguilla vulgaris the rate of heat-adaptation increases with temperature. The results on the three invertebrates examined, Dinophilus gyrociliatus, Dreissena polymorpha, and Laomedea Dinophilus loveni, do not make necessary a distinction between a heat-hardening and a heat-adaptation. The problem of hardening is discussed in several aspects. The results can be interpreted as a resistance adaptation. (Sjolseth-Washington) W70-09436

ALGAL CANCER AND CAUSAL SUBSTANCES IN WASTES FROM THE COAL CHEMICAL IN-DUSTRY.

Kyushu Univ., Fukuoka (Japan). Dept. of Fisheries Chemistry. S. Ishio, T. Yano, and R. Nakagana.

Presented at the 5th International Water Pollution Research Conference, held in San Francisco, July-August 1970. 8 p, 13 ref, 7 fig, 1 tab

Descriptors: *Public health, Foods, Water pollution effects, *Water pollution sources, Chemical wastes, Industrial wastes, Laboratory tests, Bottom sediments, Chromatography, Analytical techniques, Plant pathology, Plant growth regulators, *Plant disease.

Identifiers: *Algal cancer, *Porphyra tenera, *Benzanthrone, *Carcinogenic compound, Coal chemical industry.

Carcinogenic compounds which induce the algal cancer of Porphyra tenera were extracted with acetone from the bed mud polluted by wastes from the coal chemical industry. The extracts were separated in ether solution into bases, acids and neutrals. The most intensive carcinogenic potency was found in the neutral compounds. The neutrals gave two carcinogenic compounds. One was confirmed to be benzanthrone, another was a new hydrocarbon with the molecular formula C2 5H14. Benzanthrone brought about the algal cancer to all leaves of Porphyra tenera within 40 days at 10 deg C in a concentration as low as 0.2 ppm. (Sjolseth-Washington) W70-09437

ANIONIC AND NONIONIC SURFACTANT SORPTION AND DEGRADATION BY ALGAE CULTURES,

Texas Univ., Austin. Environmental Health Engineering Research Lab.
Ernst M. Davis, and Earnest F. Gloyna.

Journal of the American Oil Chemists' Society, Vol 46, No 11, p 604-608, 1969. 9 ref, 2 fig, 3 tab. NSF Grant NSF-GU-1963.

Descriptors: *Linear alkylate sulfonates, *Surfactants, Water pollution sources, *Detergents, *Degradation (Decomposition), Cyanophyta, tants, Water pollution sources, "Detergents,
*Degradation (Decomposition), Cyanophyta,
Chlorophyta, *Algae, Sorption, Waste water treatment, Cultures, Chlorella, Water pollution effects.
Identifiers: *Alkyl poly ethoxylate, *Alkyl phenol
polyethoxylate, Anionic surfactants, Nonionic surfactants, Infrared spectra.

Degradation of three surfactants has been determined by organic extraction procedures and in-frared spectroscopy. Axenic cultures of five species of blue-green algae and three species of green algae which are common to waste stabilization ponds were test organisms. Analytical data are shown comparing the effects produced by the algae cultures and a heterogeneous microcosm. Linear alkyl sulfonate was the anionic surfactant compound tested. An alkyl polyethoxylate and an alkyl phenol polyethoxylate were the nonionic test surfactants. Sorption of the compounds by the algae usually was followed by release and degradation of up to 99% of some of the component parts of the surfactant molecule. (Sjolseth-Washington)
W70-09438

5D. Waste Treatment Processes

BRITISH WATER POLLUTION CONTROL,

Samuel H. Jenkins. Environ Sci Technol, Vol 4, No 3, p 204-209, Mar 1970. 6 p, 5 fig.

Descriptors: Water pollution, *Water pollution control, Water quality, Water pollution treatment, Water quality control, Water reuse, Municipal wastes, *Sewage treatment, Water treatment, Water works, Sewage works, Waste water treatment, ment, Waste water (Pollution), Inspection, *Industrial waste treatment, Sewage effluents, Foreign countries.

Identifiers: Water quality standards, Municipal sewers, *Great Britain.

At a time when most industrial nations are seeking to control pollution of inland waters by stricter laws or new legislation, Britain can claim that many of its rivers are now in better condition than they were 20 yr ago. Regional pollution control authorities, joint treatment of industrial and municipal waste water, and an effective inspectorate system are key features of Britain's pollution control program. Manufacturers have the right to discharge effluents into public sewers. Municipalities owning the sewers have the power to set conditions for the discharges. River authorities are responsible for controlling pollution of surface and underground waters. The fact that effluents from municipal sewage treatment plants must meet requirements of the river authorities, and the law that requires municipalities to receive industrial waste have compelled local authorities to control discharge of pelled local authorities to control discharge of these wastes to public sewers. To ensure that manufacturers comply with the legal consent received from the municipalities, local authorities maintain an inspectorate service. Inspectors have powers of entry to take effluent samples. (USBR) W70-09041

A MODEL OF WATER QUALITY MANAGE-MENT UNDER UNCERTAINTY,

Chicago Univ., Ill.
For primary bibliographic entry see Field 06A. W70-09109

EFFECTIVE PHOSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE ACTIVATED SLUDGE PROCESS,

Metropolitan Sanitary District of Greater Chicago,

David R. Zenz, and Joseph R. Pivnicka. Paper presented at the 24th Annual Purdue Industrial Wastes Conference, May 6-8, 1969. 59 p, 34 fig, 4 tab, 21 ref.

Descriptors: *Phosphorus, *Phosphates, *Phosphorus compounds, *Chemical precipitation, *Chemical degradation, *Biological treatment, *Biodegradation, *Biochemistry, *Biochemical oxygen demand, *Waste water treatment, *Water pollution control, *Eutrophication, *Algal control, *Tertiary treatment, Suspended load, Pilot plants, Activated sludge, Treatment facilities. Identifiers: *Phosphorus removal, *Alum, *Aluminum sulfate, *Activated sludge process, Hanover treatment plant. *Phosphates, *Phosphorus,

treatment plant.

The objective of this experimental research was to evaluate, under actual waste water treatment plant operating conditions, a combined chemical-biological process capable of producing an effluent low in phosphorus, BOD and suspended solids. Tests were

conducted at the Hanover Park Water Reclamation Plant in Cook County, Illinois. The plant consists of a 2 mgd conventional activated sludge facility and a tertiary facility capable of treating the entire flow from the secondary facility. The secondary plant was separated into two distinct systems for the tests. Alum was added to the influent of the aeration tank of one system by a feed pump. Effluent samples, taken automatically as 24-hour composites, were analyzed for BOD, SS, VS, per cent total solids, per cent volatile solids, alkalinity, S.V.I and NH3-N. An Autoanalyzer was used for phosphorus determinations. It was found that the process can produce effluent phosphorus concentrations of 2.30 mg/l (total P) and 0.83 mg/l (soluble P) at a Al:Total P Ratio (molar basis) of 1.54 and a Al: Soluble P Ratio of 1.85. This is 83 and 93 per cent removal, respectively. Bound phosphorus was not released during anaerobic digestion. Additions of large amounts of alum did not adversely affect BOD removal efficiency, but removed higher microbial life forms in the mixed liquor. The suspended solids increased at an alum concentration of 252 mg/l. Waste sludge increased, and S.V.I decreased. Alum did not upset the anaerobic biological treatment process. (Poertner) W70-09186

REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBIOSIS, San Jose-Santa Clara Water Pollution Control

Plant, San Jose, Calif. Edward R. Becker.

Report 1968. 78 p, 26 fig, 5 tab, 31 ref. FWPCA Demonstration Grant WPC-129-01.

Descriptors: *Anaerobic digestion, *Anaerobic conditions, *Anaerobic bacteria, *Activated sludge, *Aeration, *Anaerobic treatment, *Biological treatment, *Sewage bacteria, *Sewage treatment, *Sludge treatment, *Waste water treatment, *Solids contact process, Pilot plants.

Identifiers: *Anaerobiosis, *Waste activated

sludge, Sludge volume reduction.

Description of a pilot plant demonstration of the feasibility of incorporating anaerobiosis in the activated sludge waste water treatment process to compact and reduce the volume of waste activated sludge. The process is viewed as a method that might be economically attractive to many communities that employ activated sludge treatment methods. A 12 per cent reduction in total waste sludge volume and a 22 per cent reduction in weight was exhibited. Possibilities of reducing pollution problems from effluents of secondary treatment plants by decreasing nitrites, nitrates, and phosphates were demonstrated. A pilot plant was designed and constructed to simulate the operating conditions of the San Jose - Santa Clara Water Pol-lution Control Plant. Two physically identical secondary treatment units were provided, except that an anaerobic holding tank was added to one unit. The major plant primary effluent was used as a common influent to both units. Settled activated sludge withdrawn from the final clarifier was held for detention periods of 0, 4, 6, 8, and 12 hours in the anaerobic holding tank. Samples of waste activated sludge were withdrawn regularly from both units and analyzed daily to evaluate the effectiveness of anaerobiosis in reducing waste sludge volumes. The optimum period of anaerobiosis developed with a four-hour sludge-detention period. (Poertner)
W70-09187

ODOR CONTROL METHODS, EXPERIMENTA-

TION AND APPLICATION,
Los Angeles County Sanitation District, Calif. Jay G. Kremer.

Report, 1969. 71 p, 36 fig, 13 tab, 79 ref.

Descriptors: *Odor, *Air pollution effects, *Organoleptic properties, *Waste water treatment, *Activated carbon, *Activated sludge, Pilot plants, Hydrogen sulfide, Sulfur, Cost comparisons.

Identifiers: *Odor control, *Odor evaluation, Activated sludge scrubber, Turbulent contact absorber scrubber.

Describes the field and laboratory investigations conducted by the County of Los Angeles Sanitation Districts to develop methods, procedures and equipment for odor control of air flows from wastewater treatment plants. The objectives of the project were to: develop means to quantitatively evaluate odor concentrations; formulate systems for removing odors; evaluate the systems for practicality and effectiveness; and determine costs of odor removal. A literature search revealed scant knowledge of practical methods of odor control. A method patterned after ASTM D1391 was found effective and of sufficient accuracy for making quantitative evaluations of odors. A special odor evaluation room was constructed and equipped for odor evaluations by male and female students from a nearby college. Pilot plants were constructed and tested to evaluate various methods of removing odors from air flows of waste water. These included: a conventional activated sludge scrubber; a packed-tower turbulent contact liquid scrubber using activated sludge and various chemicals; and activated carbon absorbtion. Cost comparisons, advantages, and capacities are described for the above methods and for fume incineration. A successful application of activated carbon for odor removal was made at a waste water pumping station. (Poertner) W70-09190

USES OF WASTE HEAT, Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 03C. w70-09193

UNIVERSITY ROLE IN ASTRONAUT LIFE SUPPORT SYSTEMS: WATER RECOVERY SYSTEMS,

Massachusetts Inst. of Tech., Cambridge. Center for Space Research.

John R. Tole. National Aeronautics and Space Administration

Contractor Report NASA CR-1629, June 1970. 55 p, 11 fig, 3 tab, 76 ref. NASA Contract No NGR-22-009-312. Descriptors: *Water reuse, *Reclaimed water, *Water quality, *Monitoring, *Research facilities, Grants, Universities, Research and development,

Contracts, Desalination apparatus, Distillation, Systems analysis, Waste water treatment. Identifiers: *National Aeronautics and Space Ad-

ministration, Life support systems.

One of the vital spacecraft life support systems is that used to supply water. Short duration missions allow storage of sufficient water, but for long duration missions, the weight of such a supply becomes unacceptable. This paper reviews techniques for recovering potable drinking and wash water from spacecraft waste water. Emphasis is placed on problem areas which exist in such recovery and which may be suitable topics for university type research. Areas covered include nature of waste waters which might be processed, potability requirements and monitoring techniques, existing and possible future recovery techniques, means of selecting a suitable technique from a number of different types, and problems of a fringe nature such as means of monitoring body mass to keep track of human water exchange. An attempt is made to stimulate new ideas based on present knowledge. (Knapp-USGS) W70-09236

FINAL REPORT ON REVERSE OSMOSIS MEMBRANES CONTAINING GRAPHITIC OX-

Westinghouse Electric Corp., Pittsburgh, Pa. For primary bibliographic entry see Field 03A. W70-09245

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

HYDROCASTING REVERSE OSMOSIS MEM-BRANES.

Hydronautics, Inc., Laurel, Md. For primary bibliographic entry see Field 03A.

IN-PLANT WASTE REDUCTION,

Humble Oil and Refining Co., Baytown, Tex. Sidney O. Brady. Journal of the Water Pollution Control Federation, Vol 41, No 8, p 1516-1523, August 1969. 4 fig.

Descriptors: *Industrial wastes, *Oil wastes, *Waste water disposal, *Waste disposal, *Reduction, *Waste water treatment, Disposal, Chemicals,

Operations. Identifiers: *Process modification, *Refinery, Petroleum wastes.

In-plant waste reduction covers a multitude of practices many of which are preventive in nature.

These practices play an important role in reducing the overall waste discharge from an industry, but in many areas probably are not considered as part of the waste control effort. Five preventative measures are discussed: (1) design, (2) process modification, (3) recovery and utilization, (4) local pretreatment or disposal, (5) operation control. Each measure is discussed from the petroleum industries viewpoint. Engineering design considerations commonly used are (a) separate drainage and sewer systems, (b) segration of waste water streams, and (c) water conservation. Design modifications that effect waste control and that may be considered as preventative measures are process selection and process and chemical losses. A special type of process design which contributes to economical waste reduction is that of waste plants to simple collection and sale of the chemicals. Several examples are given of local pretreatment or disposal which is performed in-plant. The dilemma confronting those agencies concerned with making a pollution loading charge versus raw material consumed is presented. The vast number of plants is different products, processes, etc., make this type of comparison impossible. (Hancuff-Texas) W70-09316

FILTRATION OF WASTE PLANT EFFLUENTS, Wayne State Univ., Detroit, Mich. Henry A. Dirasian.

Water and Sewage Works, Vol 117, No 3, p 84-88, March 1970. 4 fig, 4 tab, 9 ref.

Descriptors: *Waste Water treatment, *Materials, *Effluents, *Filtration, *Diatomaceous-earth, Activated carbon, Flyash, Biochemical oxygen demand, Chemical oxygen demand. Identifiers: Suspended solids.

The combination of filtration characteristics of diatomaceous earth and adsorptive properties of activated carbon provided efficient removal of contaminants from waste water treatment plant effluents. The study was broken down into 3 phases: (1) diatomaceous earth alone was used as the filtering medium, (2) diatomaceous earth was used with varying concentrations of activated carbon and, (3) flyash alone constituted the filtering medium. The results of this feasibility study have verified the hypothesis that additional treatment of waste treatment plant effluents is possible using filter aids with pressure type filters. Best results were obtained using diatomaceous earth as the filtering medium with the inclusion of activated carbon. Results with flyash filter were not very impressive. It appears desirable to continue studies on the flyash filter since it is believed that properly graded and washed flyash could yield BOD and SS removals substantially higher than those attained. Since the study was a feasibility type, no attempt was made to determine the most efficient methods of operation nor any detailed cost analysis. (Shankar-Texas) W70-09317

POLYMER PLUS MAGNETIC FIELD USED TO TREAT PARAMAGNETIC SLURRIES,

Jones and Laughlin Steel Corp., Pittsburgh, Pa. D. F. Peck, and T. J. McBride. Water and Sewage Works, Vol 116, No 11, November 1969. 9 fig.

Descriptors: *Waste water treatment, *Industrial wastes, Waste water, *Flocculation, Magnetic studies, *Slurries sedimentation.

Identifiers: *Polymer, Paramagnetics, Settling rate, Oxygen furnance, Suspended solids, Magneticpolymer process.

Certain aqueous steel mill wastes have proven dif-ficult to treat from the standpoint of color and solids removal. Conventional treatment facilities require low over-flow rates and sizeable space requirements. The development of a new process which improves solids separation from the paramagnetic waste slurries is discussed. The process consists of (1) treatment with an anionic polymer and (2) controlled exposure to a magnetic field prior to settling in conventional equipment. Settling rates by the magnetic-polymer process have been shown to be higher than any other treat-ment for similar wastes. The polymer which gave the best results when used in combination with a magnet was a high molecular weight water soluble anaionic material of the polyacrylamide class. A brief account of proposed mechanics of double floccing for paramagnetic slurries is presented. A summary of advantages of the magnetic-polymer flocculation process as applied to paramagnetic slurries is given. The combination process results in a high degree of apparent color removal. (Shankar-W70-09318

ADVANCES IN HANDLING GAS CHLORINE,

Capitol Controls Co., Inc., Colmar, Pa. Gerald F. Connell, and John J. Fetch. Journal of the Water Pollution Control Federation, Vol 41, No 8, p 1505-1515, August 1969. 7 fig, 10

Descriptors: *Chlorine, *Chlorination, *Materials, *Safety, *Plastics, Gases, Oxidation, Temperature, Disinfection, Waste water treatment. Identifiers: *All-vacuum chlorination system, *Chemical handling.

The method of gas chlorination in comparison with powder and liquid techniques is more advantageous than the other disinfection techniques because of economics and safety. An improvement to the vacuum operated solution feed system is presented in the form of the all-vacuum method of chlorination whereby the chlorinator is mounted directly on top of the chlorine cylinder. Several chlorine myths are discussed such as: chlorine explosions or burning. The element chlorine is non-explosive, will not burn, and is heavier than air. The economics and safety of liquid bleach versus gaseous chlorine are discussed, and it is shown that gas is the most economical technique for feeding chlorine because it requires less material and has least cost per pound. Other misunderstood facts about chlorination are also discussed such as 'frozen' chlorine lines. Internal and external materials of construction are discussed as well as other safety aspects. (Hancuff-Texas)

BAFFLED BIOLOGICAL BASIS FOR TREAT-ING POULTRY PLANT WASTES, Syracuse Univ., N.Y. Nelson L. Nemerow.

Journal of the Water Pollution Control Federation, Vol 41, No 9, p 1602-1612, September 1969. 8 fig.

Descriptors: *Biological treatment, *Oxidation, Lagoons, *Baffles, *Waste water treatment, *Poultry, Industrial wastes, Lagoons, Ponds, Poultry, Industrial wastes, Lagoons, Ponds, Photosynthesis, Costs, Efficiency, Biochemical oxygen demand, Algae, Sedimentation, Settling hasins Identifiers: *Chickens, Food wastes, Poultry wastes.

A poultry plant in Millsborough, Delaware, processed 10,000 chickens per hour with a waste water of 40,000 gph, and an effluent of 2,500 lb BOD5/day at an average BOD of 630 mg/l. Because the area is commercially and recreationally of great value a program was initiated to reduce the waste water concentration at a maximum cost of \$100,000. Adequate screening followed by a two-stage oxidation pond plant utilizing over and under contact baffles in the first stage followed by chlorination provided a 85 to 95% reductions. The first stage consists of a baffled high-rate deep pond. The second state is a shallow synthetic basin. Loadings of over 200 lb/day/acre resulted in high efficiency and coliform counts of less than 10/1000 ml. The final cost was \$90,000. (Hancuff-Texas) W70-09320

EFFECT OF RECIRCULATION ON DEEP TRICKLING FILTER PERFORMANCE, Regional Inst. of Tech., Jamshedpur (India).

. Hanuamanulu.

Journal of the Water Pollution Control Federation, Vol 41, No 10, p 1803-1806, October 1969. 2 fig, 2 tab. 4 ref.

Descriptors: *Trickling filters, *Sewage treatment, *Waste water treatment, *Performance, Efficiencies, Biochemical oxygen demand, Filters. Identifiers: *Secondary treatment, *Recirculation,

Three trickling filters of 12 foot media depth at Dadar-Bombay Wastewater treatment plant were studied to determine the effect of recirculation on efficiency. One was provided with recirculation while the other two were without it. The filter with recirculation consisted of closed filter with artificial ventilation by means of blowers. The recirculation ratio was 1, the flow was 1.59 MGD, and the hydraulic loading was 23.6 MGD/acre. The 2 filters without recirculation were loaded at 14.3 MGD/acre and handled 2.4 MGD. Both types of filters were working under the same conditions of media depth, media characteristics, waste water characteristics, temperature and organic loading. The filter with recirculation achieved an efficiency of 91% while those without recirculation attained only 52%. Recirculation resulted in distributing the organic loading almost uniformly throughout the depth of the filter. The effect of recirculation will be predominant if the strength of the waste water is high. (Hancuff-Texas)
W70-09321

EUROPEAN WASTE WATER MANAGEMENT AND RESEARCH, Department of National Health and Welfare, Ed-

monton (Alberta). Public Health Engineering Div. Charles P. Fisher, and Hugh R. Eisenhauer. Water and Pollution Control, Vol 107, No 12, p 26-28. December 1969.

Descriptors: *Industrial wastes, Economics, *Waste water (Pollution), *Waste water treatment, *Management, *Research facilities, *Pollution abatement, Sewage treatment. Identifiers: Penalties.

A summary of visits to certain outstanding waste water research establishments is presented and some insight into European waste water management practices is gained. Antipollution laws in Italy are lax and apply only to the Fisheries without and references to human health. Rome draws it's drinking water supply from a receptional lake whether ing water supply from a recreational lake where sewage is directly discharged. Czekoslovakia ap-pears to be fairly advanced in waste water managepears to be fairly advanced in waste water manage-ment. A brief sketch of the projects under research in a hydraulic research institute at Bratislava is given. Vienna, a city with a population of 2 million, does not have sewage purification facilities but a plant for the city is presently under design. Ger-many was found to be the forefront of waste water nanagement. Problems of management in Gernany led to the creation of Emscher Association by Special Act passed by the Prussian Diet in 1904. All the industries and municipalities are required by law to join the Association. In Holland waste water management seems to be at its highest level. (Shankar-Texas) W70-09322

CATTLE SKIN TANNERY WASTES TREAT-MENT IN A COMPLETELY MIXED AC-TIVATED SLUDGE PILOT PLANT,

Jordan (Edward C.), Inc., Portland, Maine; and

Maine Univ., Orono.

Robert E. Hunter, and Otis T. Sproul. Journal of the Water Pollution Control Federation, Vol 41, No 10, p 1716-1725, October 1969. 3 fig, 4

Descriptors: *Waste water treatment, *Activated sludge, *Pilot plant, Industrial wastes, Operations, Efficiencies, Performance, Toxicity.

Identifiers: *Tannery Waste, *Cattle skin waste, *Leather waste, Chrome wastes, Waste characteristics, Completely mixed activated sludge, Load-

The treatment of waste water from a cattle skin tannery process always has been considered because of the high pollutional characteristics of the waste the potential toxic chemicals used in the process and the wide variety of both the quantity and characteristics of the wastes over the process day. Treatment criteria were developed for a chrome-tanning waste through which 90% organic removal was obtained. A completely mixed activated sludge pilot plant with 3,000 gallons/day capacity was constructed and operated for 27 days at varying loadings. The pilot plant consisted of the following basic units. (1) collection troughs and outfall mixing units, (2) influent pump, (3) splitter tank, (4) a primary sedimentation tank, (5) aeration tank, (6) secondary sedimentation tank, (7) air lift solids return and (8) blower. The BOD loading to the pilot plant varied from 42.5 to 80.9 lb/day. Suspended solids loading varied from 47.8 to 103.6 lb/day. Hydraulic loadings on the primary sedimentation tank varied from 216 to 440 gpd/ft sq. The primary sedimentation unit removed ap-proximately 40% of the influent BOD and about 50 to 60% of the suspended solids. BOD loading to the aeration tank ranged from 127 to 272 lb/day/1000 cu. ft. of aeration capacity. The BOD to mixed liquor suspended solids loading varied from 22 to 85 lb. Aeration times varied from 10.6 to 19.0 hours. The data were adapted to design criteria for plant treating 10,000 pounds of organics per day from the tannery and a population of 2,500. (Hancuff-Texas) W70-09324

A STATEMENT ON PHOSPHORUS, Minnesota Univ., Minneapolis.

Joseph Shapiro. Journal of the Water Pollution Control Federation, Vol 42, No 5, Part 1, Page 772-775, May 1970. 4

Descriptors: *Phosphorus, *Detergents, *Tertiary treatment, *Eutrophication, Waste water treatment, Algae, Effluents, Nutrients, Sewage treatment, Nutrients, Sewage treatment, Nutrients, Nutrients,

A paper by L. E. Kuentzel published in the October 1969 issue of the JWPCF is discussed and evaluated by Shapiro. The discussion is basically a refutation of arguments presented by Kuentzel in his challenging the efficacy of phosphorus removal for eutrophication control. Several works cited, previous to Kuentzel's, supports the fact that reduction of phorphorus in effluents through curtailed use of detergents or advance waste water treatment will reduce eutrophication of lakes significantly and will allow those already severely affected to begin their recovery through natural processes. (Han-

FLEXIBILITY KEY TO DESIGN OF MACHIN-ING PLANT'S TREATMENT FACILITIES,

Chrysler Corp., Detroit, Mich.

A. R. Balden.

Water and Sewage Works, Vol 117, No 3, March 1970. 6 fig, 2 tab.

Descriptors: *Oil, *Waste Water Treatment, *Industrial wastes, *Flexibility, *Emulsion, Sedimentation, Waste treatment, Lagoons, Cost, Floccula-tions mixing, Settling basins, Skimming. Identifiers: *Machinery Plant, *Air flotation, Grit

removal, Settled Solid, Acidification.

The waste treatment in a Toledo machining plant and the difficulty encountered in treating some of the contaminants such as oil, emulsion cleaners, etc. is explained. The waste water from the factory flows by gravity to a pump and a grit remover screens out all the large solids. The water is transformed to 2 ferred to 3 primary clarifiers by a float activated pump. The tanks are provided with drum skimmers for oil removal and Bottom Scrapers move the settled solids to a recess in the floor. After settled solids are floated oils, have been removed, the blended waste is tested to determine whether acidification will remove more oil. The blended water is treated with ammonium sulfate and the pH is adjusted. It is then treated with Air Flotation. Scum is accumulated in a sump from which it is periodically pumped and hauled to an oil reclamation site. The final treatment prior to disposal is sedimentation. The drum skimmers were later abandoned in favor of weirs, since it was noticed that skimmers led to the production of an invert emulsion which resulted in a serious interference in the efficiency of oil removal. Research is underway to increase the amount of recoverable and reusable oil from the treated waste. (Shankar-Texas)

CHARACTERISTICS OF WASTEWATER AT

DELHI, Pahlavi Univ., Shiraz (Iran).

Jatinder K. Bewtra.

Journal of the Water Pollution Control Federation, Vol 41, No 2, p 208-221, February 1969. 6 fig, 10

Descriptors: *Waste water treatment, *Sewage treatment, *Statistics, *Corrleation analysis, *Treatment facility, Biochemical oxygen demand, Probability, Kinetics.
Identifiers: *Rate constant, *Grit removal, *Delhi,

Suspended solids, Loading.

Characteristics of waste water from different stages of treatment in Okhla Sewage Works, one of the largest plants in Asia, were studied for three years. Investigated were the characteristics of grit, suspended solids, rate constants for BOD at different temperatures and correlations between waste water characteristics like BOD, volatile and total suspended solids, and volatile and total solids total suspended solids, and volatile and total solids on evaporation. Tests showed that future grit chamber design should allow removal of 0.1 mm size particles of 2.45 specific gravity at a flow of 0.49 ft/sec, mean BOD rate constant values at 20 deg were 0.186, 0.164, and 0.119/days for raw, settled and treated waste water respectively. 60-75% of suspended solids and 45 to 60% BOD were removed from the raw waste water. (Hancuff-Texremoved from the raw waste water. (Hancuff-Texas) W70-09327

DIGESTED SLUDGE DISPOSAL ON CROP

LAND, Illinois Univ., Urbana; and Metropolitan Sanitary District of Greater Chicago, Ill.
Thomas B. Hinesly, and Ben Sosewitz.
Journal of the Water Pollution Control Federation,
Vol 41, No 5, p 822-830, May 1969. 3 fig, 4 tab.

Descriptors: *Sludge disposal, *Crops, *Agriculture, *Irrigation, *Fertilizers, Stabilization, Digestion, Sludge, Sludge digestion, Nutrients, Trace elements, Odors, Infiltration. Identifiers: Chicago (Illinois).

After an exhausted study to determine the best solids disposal solution, the Metropolitan Sanitary District of Greater Chicago concluded that digestion followed by land disposal could cope with Chicago's 1000 tons/day of sludge successfully at a cost of \$20-\$23/ton. Research designed to determine groundwater contamination, the effect of heavy metals and crop irrigation parameters was conducted. At the Northeast Agromony Research Center digested sludge was applied by furrow irrigation at weekly intervals on crop land planted with corn and kenaf. The rates were 1, 0.5, 0.25, and 0 inches for a total of 6 weeks. Average corn yield was 111.9, 114.2, 96.2, and 66.3 bushels per acre, respectively. While all the results are not in for the first years research and demonstration projects on the 8 acre and 30 acre test plots some observations can be summarized. (1) The crops responded favorably to digested sludge. (2) Offenresponded ravorably to digested studge. (2) Offensive odors have not been a problem. (3) Flys were never a problem. (4) Furrow irrigation is preferred to sprinkler irrigation. (5) Application of nitrogen in amounts greater than those needed for crop reduction will increase nitrate level in drainage water. (Hancuff-Texas) W70-09328

DEGRADATION OF WASTE WATER OR-GANICS IN SOIL,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

For primary bibliographic entry see Field 05E. w70-09329

BOD AND COLOR REMOVAL FROM KRAFT

MILL WASTES, Nova Scotia Technical Coll., Halifax. D. Thirumurthi, G. McKenna, and H. G. Bown. Water and Sewage Works, Vol 116, No 12, p 491-494, December 1969. 4 fig, 3 tab, 9 ref.

Descriptors: *Biochemical oxygen demand, *Color, *Industrial wastes, *Pulp and paper industry, *Aeration, Coagulation, Laboratory tests, Lagoons, Waste water treatment, Mills. Identifiers: Alum.

The BOD and color removal characteristics from a kraft mill waste by parallel treatment with alum coagulation and a laboratory model aerated lagoon were investigated. Aerated lagoon treatment was confirmed to be an effective system for BOD removal from Kraft pulp mill wastes. However, aeration did not accomplish any significant color reduction. Alum coagulation was efficient in color removal from Kraft mill wastes. At a pH of 6, an alum dose of 0.9 mg/l removed 92.8% of color causing compounds after 5 minutes of settling. However, a bulky sludge (20% of initial waste volume) resulting from sedimentation was a potential nuisance. Under the test conditions, alum coagulation did not render a significant BOD were investigated. Aerated lagoon treatment was coagulation did not render a significant BOD removal. A combination of series, parallel or seriesparallel flow systems with alum coagulation and aerated lagoon treatment should be investigated before designing proto-type pollution control facili-ties for Kraft pulp mills. (Aguirre-Texas) W70-09330

AERATED LAGOONS TREAT SECONDARY

EFFLUENT, Van-Note-Harvey Associates, Princeton, N. J. James C. Pierce, Jr. Water and Sewage Works, Vol 117, No 5, p 162-164, May 1970. 5 fig.

Descriptors: *Activated sludge, *Aeration, *Effluents, *Tertiary treatment, *Lagoons, New Jersey, Waste water treatment.
Identifiers: *Aerated lagoons, *Contact stabilizations

The rapidly expanding population of East Windsor Township, New Jersey required an expansion of their 0.5 MGD contact stabilization plant built in 1966. Plant effluent discharged into the Millstone River, a sluggish stream with low flows in the late

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

summer. The New Jersey Department of Health promulgated stream standards requiring BOD removals of 90% at all times, including any four hour period that peak flows could come through the plant. One of the disadvantages of the existing treatment plant was the discharge of light, flocculant suspended solids over the settling tank weir during peak flow periods of the day. An additional 0.5 MGD contact stabilization plant was elected for the expansion. Both secondary plants were followed by an aerated lagoon for tertiary treatment. Lagoon aeration was accomplished with an Air-Aqua System. The tertiary lagoon was sized for 4 MGD to provide capacity for future additions. The lagoon did an effective job of handling BOD's and suspended solids discharges of up to 80 mg/l during periods of peak flows. Lagoon effluent contained 12 to 15 mg/l BOD and suspended solids. There were no settleable solids discharged from the lagoon. (Aguirre-Texas) W70-09331

RESPONSE OF DAIRY WASTE ACTIVATED SLUDGE TO EXPERIMENTAL CONDITIONS AFFECTING pH AND DISSOLVED OXYGEN CONCENTRATION, Agricultural Univ., Wageningen (Netherlands).

Lab. of Microbiology

A. D. Adamse. Water Research, Vol 2, p 703-713, 1968. 8 fig, 2 tab, 10 ref.

Descriptors: *Activated sludge, *Dairy industry, *Dissolved oxygen, *Hydrogen ion concentration, Carbohydrates, industrial wastes, Laboratory tests, Oxygen requirements, Waste water treatment.

When activated sludge was fed a normal amount of artificial dairy waste, a sharp drop of pH and dissolved oxygen (DO) was observed immediately after feeding, due to the ready dissimilation of the carbohydrate fraction of the substrate. Decomposition of the protein fraction started later, proceeded at a much lower rate, and was accompanied by a slight fall of pH and DO for a more prolonged period of time. The drop of pH during dissimilation of the carbohydrate fraction was caused by a transitory occurrence of acid intermediates in suspension. This was assumed to be due to the fact that, in spite of very vigorous aeration, the oxygen absorption rate was unable to meet the increased demand for oxygen and therefore the oxygen absorption rate became a limiting factor in the oxidation of the carbohydrate fraction of the substrate. The difference found between the dissimilation rate of the carbohydrate fraction and that of the protein fraction caused a discrepancy between the potential and actual C/N ratios of the substrate. Analyses of the acid intermediates showed that acetic acid was accumulated in the activated sludge suspension when DO was present, whereas lactic acid was found when DO was absent. (Aguirre-Texas) W70-09332

THE SEASONAL PERFORMANCE AND THE PATTERNS OF CHEMICAL AND BIOLOGICAL EVENTS IN SEWAGE LAGOONS,

Arizona State Univ., Tempe. Coll. of Engineering Sciences

John W. Klock.
Engineering Research Center Report, August 1968. 128 p, 66 fig, 13 tab, 85 ref.

Descriptors: *Biological treatment, *Chemical properties, *Effects, *Performance, *Seasonal, *Sewage lagoons, Lagoons, Oxidation lagoons, Ponds, Waste water treatment.

Two experimental lagoons were constructed to study the biochemistry of sewage lagoons and by so doing improve their operation and design for the purpose of economically producing higher quality effluents suitable for reuse in the semiarid Southwest. The program consisted of field studies of the chemical and biological characteristics and cyclic patterns of sequential phase sewage lagoons. Particular interest was devoted to the winter recession and spring recovery and the fate of coliform organisms. The seasonal range of the basic environmental factors encountered in these field studies was (1) incident light intensity (total), 185 to 775 gcal/(sq cm)-day; (2) air temperature, -7 to 44.5C; (3) influent waste water temperature, 22 to 32C; (4) ambient waste water temperature, 3 to 28C. The Eh-pH diagram was extensively used in describing the sequence of chemical and biological events that constitute the conversion of raw undiluted sewage to, first, a biologically active and fertilized 'treated waste' and secondly, to a relatively stable water. (See also W70-09334) (Aguirre-Texas) W70-09333

THERMAL ENERGY CONSERVATION AND SEQUENTIAL BIOLOGICAL PROCESSING APPLIED TO SEWAGE LAGOON DESIGN,

Arizona State Univ., Tempe. Coll. of Engineering

John W. Klock.

Engineering Research Center Report, October 1968. 28 p, 12 fig, 4 tab, 5 ref.

Descriptors: *Biological treatment, *Conservation, *Design, *Heat budget, *Sewage lagoons, Lagoons, Oxidation lagoons, Ponds, Waste water

Identifiers: *Thermal energy conservation.

This study incorporated the following principles into a reliable and simply operated lagoon system:

(a) thermal energy conservation, (b) sequential phase processing, and (c) utilization of thin plastic films to form channel barriers and heat transfer interfaces. The lagoon was designed on an 8-day flow-through-time with approximately one-half of this period in each of the first and second phases Phase I was intended to be principally a bacterial culture and phase II was an algal culture followed by limited growth of crustaceans and aquatic insects. The two phases are superimposed to improve heat utilization and prevent premature algal growth and nutrient fixation. Lagoon performance was notable by its treatment uniformity throughout the year, ranging from a low of 75.8 in the fall to a high of 78.9% BOD removal in the spring. The lagoon was clean with minimal surface solids and no odors at any time. The phase I effluent was a clear liquor and the phase II effluent had a pale green of a dilute algal culture. Seasonal performance was evaluated with studies of suspended solids reduction, deposited solids accumulation, Eh-time and pHtime patterns, BOD and COD reductions, presence of H2S and molecular oxygen, and algal activity. (See also W70-09333) (Aguirre-Texas) W70-09334

TREATMENT OF DAIRY MANURE BY LAGOONING,

Washington State Univ., Pullman. Surinder K. Bhaghat, and Donald E. Proctor. Journal of the Water Pollution Control Federation, Vol 41, No 5, p 785-795, May 1969. 9 fig, 7 tab, 6

Descriptors: *Waste water treatment, *Dairy industry, *Industrial wastes, *Lagoons, *Performance, *Pilot plants, Sewage treatment, Ponds, Biochemical oxygen demand, Anaerobic treatment, Ponds, Biochemical oxygen demand, Anaerobic treatment, Aeration, Design, Nutrients.

Identifiers: *Anaerobic treatment, *Loadings, *Characteristics, *Feed lot wastes.

A series of anaerobic ponds were operated to treat dairy cattle feed tot wastes. Approximate dimensions are pond no. 2 100x50x4, pond no. 3, 150x60x3, and pond no. 4, 30,000 sq ft area and a depth of 3 feet. Tests were run on BOD, COD, and total dry solids, volatile solids, nutrients, pH, and temperature. The ponds operated anaerobically and were satisfactory as primary treatment. Removals were above 86% for loadings of 70lb volatile solids/day/1000 cu ft. The effluents from the lagoon required further treatment. The effluent from the anaerobic lagoon is potent and can be

disposed of in either of two ways: (a) applied to thi fields, and (b) given further anaerobic treatmen The effluent from the anaerobic lagoons still retains most of the nutrients present in the raw manure waste and thus has fertilizer value. If land il not available for the disposal of the effluent from the anaerobic lagoons, secondary treatment can b provided in the form of aerated lagoons, oxidation ditches or an oxidation pond. The results of batch-type aerobic treatment indicated that an efficient BOD of 20mg/l could be achieved by a 2.0 hour aeration period, when fed the 200mg/l BOD effluent from the anaerobic ponds. (Hancuff-Tex: as) W70-09335

CONTROL MECHANISMS OPERATIVE IN A NATURAL MICROBIAL POPULATION SELECTED FOR ITS ABILITY TO DEGRADE L-LYSINE, H. EFFECTS OF FRUCTOSE AND RIBOSE IN BATCH SYSTEMS, Oklahoma State Univ. S. 11.

C. P. L. Grady, and A. F. Gaudy. Applied Microbiology, Vol 18, No 5, p 785-789. November 1969. 2 fig, 2 tab, 12 ref.

Descriptors: *Activated sludge, *Carbohydrates,s *Control, *Effects, *Microbiology, Bacteria, a Chemical oxygen demand, Population. Identifiers: Batch systems, Lysine.

A natural microbial population was acclimated to L-Lysine as the sole carbon source when ammonia nitrogen was provided in the medium. Fructose exerted a slight retarding effect upon the metabolic removal of lysine. The response was due to catabolic repression of the inducible enzyme system responsible for lysine degradation. Inhibition of activity of preformed enzymes played no part in the response. Ribose caused a slight increase in the rate of synthesis of lysine-degrading enzymes. The response of the system to carbohydrates was a function of the growth rate and of the rate of production and accumulation of metabolic inter-mediates. The compound allowing the fastest growth exhibited the most severe repression. Glucose supported relatively rapid growth (mu sub m)% (0.45/hr) with the production of many intermediates and, consequently, had a severe effect upon production of lysine-degrading enzymes. Fructose, on the other hand, allowed the cells to grow with a (mu sub m) of only 0.17/hr with the excretion of few intermediates, and its effect was rather mild. Growth on ribose was very slow (mu sub m)% (0.04/hr). The major portion of ribose utilization which did occur in the mixed substrate system may have been directed to the synthesis of RNA, which would account for the increased effi-RNA, which would account for the file the collections of the cells and allow a faster rate of synthesis decading enzymes. (See also W70sis of lysine-degrading enzymes. (See also 09337) (Aguirre-Texas)

CONTROL MECHANISMS OPERATIVE IN A NATURAL MICROBIAL POPULATION SELECTED FOR ITS ABILITY TO DEGRADE L-LYSINE, III. EFFECTS OF CAR-BOHYDRATES IN CONTINUOUS-FLOW SYSTEMS UNDER SHOCK LOAD CONDI-TIONS.

Oklahoma State Univ., Stillwater. Bioengineering

C. P. L. Grady, and A. F. Gaudy, Jr. Applied Microbiology, Vol 18, No 5, p 790-797, November 1969. 5 fig, 1 tab, 11 ref.

Descriptors: *Carbohydrates, *Control, *Effects, *Microbiology, Activated sludge, Bacteria, Chemical oxygen demand, Population. Identifiers: *Continuous-flow, *Shock loads, L-

Two naturally selected microbial populations were maintained under continuous-flow conditions with glucose or magnesium growth-limiting. The reactors were subjected to shock loads by changing the influent substrate from L-Lysine to a mixture of L-Lysine and glucose, L-Lysine and fructose, or L-Lysine and ribose. During the subsequent transient state, the following parameters were examined: lysine COD, carbohydrate COD, total COD, biological solids concentration, cell protein, enzymatic capability (lysine-degrading enzymes), and the rate of lysine removal. The carbohydrate was then removed from the influent and the same parameters were examined until a new steady state was established. In all cases, glucose and fructose caused a significant repression of the synthesis of lysine-degrading enzymes, resulting in a decrease in the enzymatic capability of the cells. In the carbonlimited reactor, the faster the flow rate, the greater was the repression, whereas, in the magnesiumlimited reactor, the slower the flow rate, the greater was the repression. The introduction of ribose into the reactors caused an initial increase in lysine enzymatic capability followed by a slight repression when ribose degradation started. (See also W70-09336) (Aguirre-Texas) W70-09337

ECONOMICS OF CANNERY WASTE TREAT-

Water Resources Engineers, Inc., Walnut Creek,

D. E. Evenson, and G. T. Orlob.

Water and Sewage Works, Vol 117, No 3, p 18-19, March 1970. 2 tab, 2 ref.

Descriptors: *Industrial wastes, *Waste water treatment, *Canneries, *Dynamic programming, Economic efficiency, Biochemical oxygen demand (BOD), Solid wastes, Disposal, Efficiencies, Costs, Size, Screens, Aeration, Lagoons, Cost comparisons.

Identifiers: *Unit processes, Algorithm, Sewer

The use of a dynamic programming algorithm to investigate the economics of cannery waste treatment was demonstrated. The algorithm found the minimum cost-size-efficiency relationships for removing BOD from a cannery waste and treating and disposing of the solid wastes. The items considered were: in-plant waste treatment, municipal waste treatment systems, and one flow of waste water, that, leaving the cannery. The in-plant treatment consisted of 5 components: screening, BOD removal from liquid wastes, ultimate liquid disposal, solid waste treatment, and disposal. Eleven alternative unit processes comprised component II. Vacuum filtration and solids oxidation were the alternatives for component IV. Two alternatives were considered for solids disposal: composting and landfill. The predominant treatment system that minimized cost consisted of screening, an aerated lagoon, and, depending on the size of the plant, either landfill or composting. An example problem illustrated the use of these minimum cost-size-efficiency relationships. A sewer service charge was assumed in order to evaluate the alternatives between treating the wastes in-plant, discharging to a municipal system, or combinations of the two. (Galwardi-Texas)

TREATMENT AND SLUDGE DISPOSAL OF WASTES FROM THE MANUFACTURE OF AC-TIVATED CARBON,

Atlas Chemical Industries, Inc., Wilmington, Del. S. A. LaRocca, W. W. Eckenfelder, Jr., and J. F. Malina, Jr.

Proceedings, Industrial Waste Conference, 23rd, p 1147-1165, May 1968. 12 fig, 5 tab.

Descriptors: *Industrial wastes, *Activated carbon, *Waste water treatment, *Sludge treatment, *Sludge disposal, Vacuum drying, Dewatering, Neutralization cyclones, Lime, Fly ash, Iron, Texas, Pilot plant, Laboratory tests, Performance. Identifiers: *Suspended solids, Marshall (Texas), Iron, Texas, Pilot, Pil Iron precipitation, Liquid cyclones.

The manufacture of activated carbon from lignite yields a highly acidic waste water containing suspended fly ash and activated carbon particles Pilot plant and laboratory studies were conducted to evaluate the most feasible means of suspended solids removal and sludge dewatering and disposal. Sedimentation and thickening, liquid cyclones, neutralization, centrifugation and vacuum filtration were considered. Neutralization of the waste to a pH of 8.0 to 8.5, eliminating post-precipitation of iron, was required to produce a stable and clear ef-fluent. Product recovery of the activated carbon particles was decided upon. A complete waste treatment flow sheet for suspended solids removal and disposal was developed. Treatment for removal of the chemical precipitate consists of neutralizing the waste to 8.0 to 8.3 with lime, thickening with polyelectrolyte and sludge dewatering by vacuum filtration. Separate removal of fly ash consists of liquid cyclones in a closed loop recirculating system and dewatering by a horizontal belt vacuum filter. (Galwardi-Texas) W70-09339

THE ORIGIN AND CHARACTERISTICS OF TOXIC WASTES, WITH PARTICULAR REFERENCE TO THE METAL INDUSTRIES,

Canning (W.) and Co. Ltd. (Gt. Brit.).

Water Pollution Control, Vol 69, No 3, p 270-280, 1970. 4 fig, 6 tab.

Descriptors: *Effluents, *Industrial wastes, Industries, Metals, Toxicity, *Waste water treatment.
Identifiers: *Metal finishing industry, *Toxic

This paper provides information on the wide range of processes used in the metal finishing and allied industries which give rise to toxic effluents, and indicates the nature of those effluents. Many of the processes are used in the preparation of, and for the protection and/or decoration of, a variety of metal and non-metallic surfaces. These processes include degreasing, pickling, dipping, stripping, etching, brightening, and polishing, and the production of corrosion-resistant, wear resistant or decorative films and deposits by chemical or electrochemical means. The paper indicates the general nature and ranges of composition of mixed effluent flows from differing plating and anodizing sequences, including the usual pre-cleaning processes but excluding any effects from the disposal of strong waste processing solutions. Typical effluents from an automatic plant for copper, nickel and chromium plating of zinc-base diecastings; from nickel, copper, nickel and chromium plating of ABS type plastics; from a hard chromium plating plant; from an automatic barrel zinc and cadmium plating and passivating plant; from a mixed manually-operated barrel and rack plating plant; and from a sulfuric acid anodizing plant, including chemical bright dipping, are presented. (Aguirre-Texas)

EFFECT OF TOXIC WASTES ON TREATMENT PROCESSES AND WATERCOURSES,

Water Pollution Research Lab., Stevenage (En-

gland). S. Jackson, and V. M. Brown. Water Pollution Control, Vol 69, No 3, p 292-313,

Descriptors: *Biological treatment, *Water pollution, Effects, Toxicity, Wastes, Anaerobic digestion, Watercourses, *Waste water treatment. Identifiers: *Toxic wastes.

Anaerobic digestion of sewage sludge is more sensitive than aerobic sewage treatment to inhibition by toxic substances, notably chlorinated organic compounds and heavy metals. Nitrification is the most sensitive aspect of the aerobic processes, although considerable acclimatization to inhibitors is possible. In general, biological treatment processes are able to protect watercourses from a variety of toxic

organic compounds, after acclimatization at least, by degrading them; others are removed, to different extents, by volatization, adsorption or precipitation. Quite large proportions of some organic substances, and of some heavy metals, are not removed, and pass on to the receiving watercourse. The impact of toxic substances on watercourses is usually assessed in terms of their toxicity to fish. Although this is a very important criterion, it must be borne in mind that the presence of a population of fish does not guarantee the wholesomeness of a watercourse in all respects. Data are available on the toxicity of many substances to fish but they are usually limited to determinations of the LC50 in 48 to 96 hours at high concentrations of poison. There is still great uncertainty about the long-term toxic effects of much lower concentrations under natural conditions. Further investigations are in progress to provide a really satisfactory basis for defining toxic limits under natural conditions. (Aguirre-Texas) W70-09341

WATER TECHNOLOGY, Rice (Cyrus Wm.) and Co., Pittsburgh, Pa. For primary bibliographic entry see Field 03A.

FORAGE CROP IRRIGATION WITH OXIDA-

TION POND EFFLUENT,
Mississippi State Univ., State College. Water Resources Research Inst.

James B. Allen, and John C. McWhorter. Available from NTIS as PB-193 705, \$3.00 in

paper copy, \$0.65 in microfiche. Water Resources Research Institute, Completion Report, July, 1970. 31 p, 9 tab, 6 fig, 12 ref, append. OWRR Project A-040-MISS (2).

Descriptors: *Irrigation, *Oxidation lagoons, Effluents, Mississippi, *Sundangrass, Crops, *Forage grasses, Biochemical oxygen demand, Coliform, Nutrients, *Water reuse, *Crop production, Waste water treatment, Forages, Nitrogen, Phosphates, Wester witer disress! Waste water disposal. Identifiers: Sudax forage.

It is a matter of public concern that effluents from oxidation lagoons have caused high BOD, coliform, and nutrient levels in the receiving streams. The purpose of this study was to investigate irrigation as a means of disposing of oxidation pond effluent before it reaches streams. Test plots of Sudax forage were furrow irrigated using three irrigation treatments (oxidation pond effluent, conventional irrigation and no irrigation) and two nitrogen fertilizer levels (0 and 240 lbs/acre). A total of 13.4 inches of water was applied during the June-Sep-tember growing season, and rainfall was 15.9 inches. The yield response to irrigation was small because of a high ground water level in the test plot area. Yield response to nutrients contained in the oxidation pond effluent were also small. These nutrients were not sufficient to maintain a high level of crop production. No problems were encountered with odor, waterlogging of the soil, or reduction of the infiltration capacity of the soil. However, high ground water levels prevented the use of the plot area for the disposal of oxidation pond effluent during the late winter of 1969-70. W70-09423

SEWAGE PLANT GRINDER PUMP,

Coast Guard, Baltimore, Md. Field Testing and Development Center.
O. M. Halstad.

Available from NTIS as AD-706 709, \$3.00 in paper copy, \$0.65 in microfiche. Phase 1, Rept no USCG-506, 12 Mar 70. 13 p, 6 fig.

Descriptors: *Sewage, Ships, Pumps, Sewage disposal, Wastes, Waste disposal. Identifiers: Macerator, Comminutor, Grinder.

Evaluation of a grinder pump as an improved means of waste solids comminution. Performance

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

of the grinder pump compared to expanded metal screen hydraulic comminutor in its ability to break up waste solids. Efficiency of the grinder pump shown to be superior to expanded metal screen hydraulic comminutor. W70-09446

AND WASTE PRELIMINARY WATER MANAGEMENT PLAN.

Sacramento Regional Area Planning Commission,

Available from NTIS as PB-191 351, \$3.00 in paper copy, \$0.65 in microfiche. Report to the Sacramento Regional Area Planning Commission, November, 1969. 126 p.

Descriptors: *Waste water treatment, *Sewage systems, *Water supply, Water demand, Waste

Identifiers: Sacramento County, Yolo County, Placer County, El Dorado County, Folsom, Galt,

A considerable amount of water and waste management planning has been done by individual entities within the Sacramento regional area during the past several years. As a result, a good base has been established for solving problems and planning for future development. The predicted future growth, a 40 percent increase in population by 1980 and 73 percent by 1990, indicates further demands will be made upon the land, water and air. At the present time there are 50 waste treatment facilities located in Sacramento County. With the increasing demands on the water resources of the region for water supply, recreation and aesthetic enjoyment, additional constraints will be placed upon waste disposal in the future. The long range waste management plan envisions maximizing waste water reclamation particularly in areas such Woodland, Davis, Roseville and Placerville which are adjacent to agricultural areas. In northeast Sacramento County groundwater recharge with reclaimed waste water also appears possible. Consolidation of facilities in Sacramento County appears feasible and desirable to eliminate a number of the small waste treatment plants. The construction of a joint outfall for conveying treated waste water from West Sacramento to Hood appears less costly than advanced waste treatment. In areas outside of Metropolitan Sacramento, future waste treatment and disposal needs can be met for the most part by expanding existing facilities, possibly adding advanced waste treatment. W70-09453

AUTOMATED ACTIVATED SLUDGE PLANTS WITH RESPIRATORY METABOLISM CON-TROL.

Omnium d'Assainissement, Paris (France). P. Brouzes.

In: Advances in Water Pollution Research, Water Pollution Research, Proceedings Fourth International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, Sec II, Paper 5, September 1968. 12 p, 9 fig, 6 ref.

Descriptors: *Activated sludge, *Automation, *Control, *Metabolism, *Respiration, Automatic control, Control systems, Growth rates, Oxygen demand, Oxygen requirements Identifiers: Auto-oxidation.

Sewage treatment plants have profited little from the numerous studies and the basic theories relating to the growth of cultures of micro-organisms. The main reason is probably the difficulty in controlling instantaneously the pollution load received at these plants. As a result, the energy consumption for oxygenation is excessive and the growth rate of the culture varies uncontrolled. The pollution load and its variations can be determined with very good approximation, by treating the characteristic parameters by means of an analog computer. The energy consumption for oxygenation is reduced,

since it corresponds at each moment to the actual pollution load. Control equipment varying in type from the simpler regulator to the analog computer, have been adopted for adjusting the two basic factors of air input and excess sludge removal. Excess sludge removal is achieved automatically in accordance with the desired operating conditions and the instantaneous pollution load, which the air input is adjusted so as to maintain a constant concentration of dissolved oxygen. Applying this control over the growth rate has enabled the power used to be reduced by 25% with a slight increase in the amount of BOD removal by the aeration plant. (See also W70-08627) (Aguirre-Texas) W70-09502

ENERGY AND HYDRAULIC TESTS ON MECHANICAL AERATION SYSTEMS,

Emschergenossenschaft, Essen (West Germany). E. Knop, and K. H. Kalbskopf.

In: Advances in Water Pollution Research, Proceedings Fourth International Conference on Water Pollution Research, held in Prague, Czechoslavakia, April 21-25, 1969: Pergamon Press, Ltd, Sec II, Paper 11, September 1968. 14 p, 15 fig, 2 ref.

Descriptors: *Activated sludge, *Energy, *Hydraulics, *Testing, Aerating, Energy transfer, Equipment, Hydraulic properties, Hydraulic radius, Mechanical equipment, Mixing. Identifiers: *Mechanical surface aerators.

The design and operation of mechanical surface aerators may be subdivided into three groups which may be termed cone aerators, jet aerators, and bruch aerators. The results achieved so far and the general observations made on a BSK turbine, various types of simplex cones, and a mammoth rotor by the Emscher Association are presented. In the activated sludge process, mechanical surface aerators must not only furnish the oxygen requirements for biological treatment, but they must also ensure turbulent mixing of waste water and activated sludge, preventing sludge deposits within the aeration tank by creating sufficiently high velocities When a propeller was used in a square tank of 1200 m cubed, the power required to obtain a velocity of some 30 m/sec was 2 W/m cubed of tank contents. In treating waste water by the activated sludge process, the power required for the aeration tank is generally higher: depending on the shape and size of the tank and the applied loading, it is 5W/m cubed to 20 W/m cubed. Thus, most of the power is required for the aeration process. The required power expenditure, at the Emscher Mouth pilot plant, ranged from about 0.1 kWh/kg BOD5-removed at an influent BOD5 of 200 mg/l to 0.4 kWh/kg BOD5-removed at an influent BOD5 of 60 mg/l. The corresponding oxygen requirements ranged from 0.25 to 0.75 kg O2/kg BOD5 in influent. (See also W70-08627) (Aguirre-Texas)

FLUCTUATION OF EFFLUENT QUALITY IN ACTIVATED SLUDGE PLANTS,

Bureau of Sewage Treatment Operation Pribram (Czechoslovakia).

In: Advances in Water Pollution Research, Proceedings Fourth International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, Sec II, Paper 2, September 1968. 8 p, 3 fig, 22 ref.

Descriptors: *Activated sludge, *Effluents, *Fluctuations, *Kinetics, Biochemical oxygen demand, Chemical oxygen demand, Mathematical models. Identifiers: Extended aeration, High-rate activated shudas. sludge, Resistance index, Sludge activity index, Volatile suspended solids.

The fluctuations of effluent quality from various modifications of activated sludge systems are described in terms of the theory of kinetics of activated sludge processes. Because metabolism of

complex substances brings about a significan change in structure and composition, it is suggested that the filtrate BOD removal rate (sludge activity index) per unit weight of organisms is a function of the availability index rather than a function of sub strate concentration. The suspended solids remove rate is primarily a function of sludge settlini characteristics. At the present time there is no war to control the sludge settling conditions. It is predicted that the resistance index increases with decreasing sludge activity index and vice versa. The reliability of the proposed model has been borned. out by large-scale experimental data. As far as effluent BOD is concerned, the unremoved hourly BOD in a 24-hour period varied for small extende aeration plants, conventional activated sludge plants and high-rate activated sludge plants within the limits of 60 to 160%, 60 to 170% and 35 to 185% of the average hourly unremoved BODD respectively. (See also W70-08627) (Aguirre-Tex-W70-09504

THICKENING CHARACTERISTICS OF AC-TIVATED SLUDGE,

Illinois Univ., Urbana.

Richard I. Dick.

In: Advances in Water Pollution Research, Proceedings Fourth International Conference on Water Pollution Research, held in Prague,; Czechoslovakia April 21-25, 1969: London, Per-gamon Press, Ltd, Sec II, Paper 18, September: gamon Fress, Eta, 151, 1968. 15 p, 9 fig, 1 tab, 11 ref.

Descriptors: *Activated sludge, *Consolidation, Areal, Mathematical models, Rheology, Sedimentation, Settling velocity, Sludge, Yield strength. Identifiers: *Characteristics, *Thickening.

The settling characteristics of activated sludge differ from those of the ideal suspension on which gravity thickening theories are based. The 'nonideal' behavior of activated sludge was interpreted in terms of the rheological properties of the suspension. A conceptual model of the hypothesized mechanism of subsidence of activated sludge was developed based on an analysis of forces acting on a mass of sludge. The resulting mathematical expression was inconsistent with prevailing theories of thickening, but was in close agreement with the observed settling behavior of activated sludge. The relative magnitude of the interparticle force was shown to be related to the yield strength of the sludge. It was concluded that the reason activated sludge failed to conform to prevailing theories of thickening was that it had a yield strength at ordi-nary mixed liquor suspended solids concentrations. The interparticle forces cause a reduction in settling velocity which is not considered in present theories relating to the area requirement for thickeners. The area of the thickening portion of a settling basin need not be considered to be inalterably established by the settling velocity of the rate-limiting concentration of activated sludge. The area can be reduced, or the capacity of an existing basin can be increased, by minimizing the reduction in settling velocity due to interparticle forces with the sludge, by controlling the depth and mixing conditions in the settling basin. (See also W70-08627) (Aguirre-Texas)

KINETIC ASPECTS OF THE TREATMENT OF PHENOLIC WASTES,

P. W. Graham.

In: Advances in Water Pollution Research, Proceedings Fourth International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, Sec II, Paper 8, September 1968. 15 p, 5 fig, 3 tab.

Descriptors: *Activated sludge, *Kinetics, *Phenols, *Treatment, *Wastes, Biological treatment, Efficiencies, Industrial wastes, Mathematical models, Oil industry. Identifiers: Mass loading.

t is now well known that strong phenolic wastes are amenable to biological oxidation, but the efortts of the concentration of the waste on the iynamics of the process have not received a great leal of attention. Work on the kinetics of the treatnent of such effluents derived from gas manufacture is described. Chromatographic and other analytical procedures have been used to follow the rate of oxidation of the phenolic material contained therein, and the information has been supple-mented by bacterial counts. Gas liquors were biologically treated over a wide range of dilutions and retention times. The maximum flow rate that could be applied successfully was dependent on the dilution: as the dilution was increased, so the maximum flow rate could be increased. The kinetics of simple continuous culture were used to demonstrate that the concentration of ammonium chloride in the liquor was responsible, in part at least, for the observed dilution effects. It was concluded that design criteria based solely on the concentration or mass loading of oxidizable substrate may be inadquate, and should not be applied over a wide range of concentrations, unless the inhibitory effects of other constituents are known. (See also W70-08627) (Aguirre-Texas) W70-09506

PHOSPHORUS REMOVAL WITH FERRIC IRON AND ALUMINUM,

Karlsruhe Univ. (West Germany).

Johannes Popel.

Fourth International Conference on Water Pollution Research, Sec III, Paper 1, September 1968. 11 p, 4 fig, 6 tab, 10 ref.

Descriptors: *Aluminum, *Iron, *Phosphorus, Coagulation, Costs, Efficiencies, Mathematical models, Nutrients, Sewage treatment. Identifiers: *Phosphorus removal.

Methods for removing the nutrients in treated sewage prior to discharge have been worked out and in the case of phosphorus, coagulation with ferric or aluminum salts has been proved to be a relia-ble process. A combination of two theories describes the removal mechanism: (a) adsorption describes the femoval mechanism: (a) adsorption of the phosphates on hydroxide flocs and (b) the formation of FePO4 or AlPO4 by precipitation. The proposed model, derived on the basis of the mechanism of phosphate binding with the respective coagulant metal ions, is applicable to generalizing and forecasting removal efficiencies in the range of 45 to 95%. The model is also applicable to sewage containing polyphosphates when relating sewage containing polyphosphates when relating the relative amount of coagulant to moles to total phosphorus P. Compared to the relative amount of coagulant, the influence of the initial phosphorus concentration on the removal efficiency will be significant only when the initial P varies over a wide range. Subsequent coagulation produces a better effluent quality and more consistant removal results than simultaneous coagulation. Ferric results than simultaneous coagulation. Ferric chloride is slightly less efficient than aluminum sulfate on the basis of moles of coagulant ion applied per mole of phosphorus, while the coagulation product of ferric chloride is generally better aettleable than that of aluminum sulfate. A relative phosphorus removal exceeding 90 to 95% is economically not justified. For removal efficiencies of the above magnitude the costs for coagulants of the above magnitude the costs for coagulants will vary depending upon the coagulant and the response of the sewage towards the coagulation process from approximately 3-10 DM/cap. year under German conditions. (See also W70-08627) (Aguirre-Texas) W70-09507

MICROBIOLOGY OF A WASTE STABILIZA-

TION POND, Central Public Health Engineering Research Inst.,

Nagpur (India). M. V. Bopandikar.

In: Advances in Water Pollution Research, Proceedings Fourth International Conference on Water Pollution Research, held in Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, Sec II, Paper 16, September 1968. 7 p, 32 ref.

Descriptors: *Biological treatment, *Microbiology, *Oxidation lagoons, Bacteria, Efficiencies, Lagoons, Microorganisms, Organic Loading, Pathogenic bacteria, Ponds, Viruses. Identifiers: *Bacterial removal, Viral removal.

Stabilization ponds developed by the author in India successfully treat sewage with an average BOD of 300 mg/l to 10 mg/l at a cost of only Rs. 40,000/MGD as against Rs. 1,000,000/MGD with conventional treatment. No work, however, has been done in India on the reduction of pathogens by pond stabilization treatment. Many variables affect the types and quantities of enteric viruses that occur in sewage and the limitations of available techniques for their detection further complicate attempts to judge their significance. A review of the techniques developed for sampling and concentration of viruses from large volumes of water is presented. Methods employed for collecting sewage samples for quantitative determination of viruses include: (1) the gauge pad or swab method, (2) resin adsorption method, and (3) ultra-centrifugation. It is shown that conventional secondary treatment (including chlorination) is not effective in removing virus contamination. However, marked reduction in the yield of viruses occurred during passages through oxidation ponds. Reduction in coliforms of fecal E. coli and fecal streptococci during 30 days passage through oxidation ponds ranged between 96.0 and 99.9%. (See also W70-08627) (Aguirre-Texas) W70-09508

INVESTIGATION ON THE CONTROL OF

FILAMENTOUS BULKING, Instituut voor Gezondheidstechniek TNO, Delft (Netherlands).

A. Pasveer.

In: Advances in Water Pollution Research, m: Advances in Water Pollution Research, Proceedings Fourth International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, Sec II, Paper 14, September 1968. 7 p, 4 tab, 15 ref.

Descriptors: *Activated sludge, *Control, Bacteria, Biological treatment, Waste water treatment. Identifiers: *Bulking, *Filamentous, *Escherichia

An effort was made to gain further understanding of the phenomenon of bulking by isolating the causative organism and studying its properties. These properties will undoubtedly be influenced by the conditions in the activated sludge floc. Therefore, the conditions in the floc and at the floc boundary were also studied. Two years of investigation of an oxidation ditch with bulking sludge resulted in the conclusion that oxygen supply, growth of filamentous organisms, nitrification and denitrification were in some way connected. The causitive organism was found to be Escherichia coli, which shows filamentous growth at pH 5 to 6. Microscopically, the filamentous growth of E. coli is singularly like that of Sphaerotilus. High loads (of carbohydrates) together with a nitrifying flora prevail-ing in the activated sludge may lead to conditions in which E. coli can thrive in the floc in filamentous form. It is not claimed that every case of filamentous sludge must necessarily be a coli infected sludge. It is believed nevertheless that this type may be rather common, in light of the explanation given and the results of other investigators. (See also W70-08627) (Aguirre-Texas)

COMPARISON OF AERATION EFFICIENCY UNDER PROCESS CONDITIONS,

Rolf Kayser. In: Advances in Water Pollution Research, Proceedings Fourth International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, Sec II, Paper 10, September 1968. 10 p, 5 fig, 1 tab, 6 ref.

Descriptors: *Activated sludge, *Aeration, *Efficiencies, Biological treatment, Oxygenation, Oxygen requirements. Identifiers: *Process conditions.

Oxygenation capacity is generally determined in tap water and also, in order to approach process conditions more closely, in biologically purified sewage and tap water with detergents. To do these tests it is either necessary to take the aeration tank out of operation or to construct special test plants. The aim of this work was to work out methods and techniques for determining oxygenation capacity and aeration efficiency under process conditions. Under process conditions the oxygenation capacity and thus also the aeration efficiency can be measured in non-steady state or in steady state experiments. Both methods give the same results. Errors occur less easily if measurements are made in nonsteady state experiments, when the overall transfer coefficient can be determined independently of calibration errors of the oxygen electrode. The only measurements necessary for the determination of the oxygenation capacity are: (1) oxygen content in the aeration tank, and (2) respiration rate of the activated sludge. Both values can be measured easiactivated studge. Both values can be measured easily using a membrane covered oxygen electrode. An experimental evaluation with activated sludge revealed a constant oxygen content of 8.1 mg/l and a respiration rate of 11.7 mg/l-hr in a non-steady state experiment. (See also W70-08627) (Aguirre-Toxyge) Texas) W70-09510

5E. Ultimate Disposal of Wastes

DISPOSAL OF BRINE BY SOLAR EVAPORA-TION: FIELD EXPERIMENTS,

New Mexico State Univ., University Park For primary bibliographic entry see Field 02D. W70-09150

DEGRADATION OF WASTE WATER OR-

GANICS IN SOIL,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Richard E. Thomas, and Thomas W. Bendixen. Journal of the Water Pollution Control Federation, Vol 41, No 5, p 808-813, May 1969. 3 tab, 17 ref.

Descriptors: *Soils, *Sludge disposal, *Digestion, *Soil disposal, Yields, Sludge treatment, Costs, Soil microorganisms, Fertility, Fertilizers, Organic wastes, Waste water. Identifiers: *Loadings.

Land disposal of liquid sludge is economically competitive with other disposal and can have the added petitive with other disposal and can have the dated attractiveness of being beneficial to the land. The use of land disposal for liquid sludge reduce sludge disposal costs to about \$10/ton of dry solids. The results of a series of lysimeter studies show that microorganisms can digest much of the organic carbon contained in primary and secondary waste water effluent. About 80% of organic carbon from septic tank effluent was digested under a wide variety of conditions. Large variations in temperature, loading rate and duration of dosing had no effect on the percentage of organic carbon which was degraded. Organic carbon application rates up to degraded. Organic carbon application rates up to 31 tons/year/acre resulted in soil residues of less than 3 tons/year/acre. Based on typical values for the composition of sludge this would be equal to 100 tons/year/acre of dried digested sludge solids. (Hancuff-Texas) W70-09329

5F. Water Treatment and **Ouality Alteration**

CONTINUOUS COUNTERCURRENT EXCHANGE.

Ind Water Eng, Vol 7, No 2, p 18-38, Feb 1970. 21 p, 12 fig, 8 ref.

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F-Water Treatment and Quality Alteration

Descriptors: *Ion exchange, Chemistry, Chemical engineering, *Capital costs, Distillation, *Demineralization, Chromatography, Water softening, Absorption, Economics Brines, Industrial plants, Fluids, *Resins, Flow rates, Technology, *Water treatment, Apparatus, Waste water treatment, Boiler feed water

Identifiers: Demineralizers, Exchange capacity

Unitl the present decade, the development of ion-exchange technology has been based on improvements in the chemistry of the process, with new resins creating new possibilities. A change has taken place, however, with new engineering techniques the dominating factor in development. The Asahi process is very successful, as attested by the many plants built to this design and operating, not only in Japan where the process was developed originally, but also in the U S, Britain, and France. Success of the Asahi process is the result of the essential simplicity. Over 70 continuous countercurrent ion-exchange plants have been designed by Chem-Seps and installed for demineralizing, dealkalizing, and softening water. This process is not dissimilar in principle from the Asahi process, the plant consisting of a closed cycle of adsorption and regeneration vessels in which the resin remains static for a service cycle, interrupted by short periods for resin movement. The difference in technique is essentially one of hydraulics. The continuous system of Paterson Candy is based on a fluidized bed contractor, differing in several respects from an intermittently moved packed bed. (USBR) W70-09037

RADIOTRACER STUDIES ON RAPID SAND

FILTRATION, Georgia Inst. of Tech., Atlanta. Engineering Ex-

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

T. F. Craft, and Geoffrey G. Eichholz.

Available from NTIS as PB-193 681, \$3.00 in paper copy, \$0.65 in microfiche. Engineering Experiment Station, Georgia Institute of Technology, EES Project E-600-705, June 1970. 59 p. OWRR Project B-020-GA (2).

Descriptors: *Rapid sand filters, *Porous media filter, *Radioactive tracers, *Water treatment, *Filtering system, Cesium-137, Filter sands, Radioisotopes, Adsorption, Particle shape, Particle size, Pores, Porosity, Colloids, Flocculation.

The research was designed to provide information on the basic mechanism involved in the action of porous media filters and provide information for improvement of water filter design. Both the theoretical and practical aspects of rapid sand filtration were investigated. Radiotracer techniques were used to measure accumulations of suspended matter in porous filter beds. Filter coefficients were calculated and were used in determining the mechanisms involved when suspended particles are trapped by a porous medium, such as sand or anthracite. Experimental evidence shows that three antification actions occur-physical hindrance, interstitial sieving, and the physico-chemical van der Waals and double layer forces. The particular mechanism by which a given particle is trapped in a porous medium is determined primarily by the size of the particle. There is a gradual transition between applicable mechanisms, but the relative effectiveness desands on the particle. effectiveness depends on the particle size. The effectiveness of anthracite and normally graded, reverse graded and uniform sand was evaluated in a series of long filter runs. From the standpoint of head loss, anthracite plus sand or anthracite alone is superior. Other media in order of decreasing efis subcriot. Other friedly in order of decreasing effectiveness are reverse graded sand, uniform sand, and normally graded sand. When all factors are considered, anthracite plus sand was found to be the best choice for filter media. The report contains 22 illustrations and 9 references. (Conway-Georgia Tech) W70-09091

A MODEL OF WATER QUALITY MANAGE-MENT UNDER UNCERTAINTY, Chicago Univ., III.

For primary bibliographic entry see Field 06A. W70-09109

5G. Water Quality Control

WATER QUALITY PLANNING AND MANAGE-MENT (PLANNING ESSENTIAL TO INSURE WATER QUALITY),

California State Water Resources Control Board,

Philip N. Storrs, and Jerome B. Gilbert. American Water Works Assn. Journal, Vol 62, No 3, Mar 1970, p 141-144.

Descriptors: *Water resources development, *Water quality, *Management, *Planning, Water users, Damages, Maintenance, Water quality conusers, Damages, Maintenance, Water quanty con-trol, Water requirements, Water demand, Water management (Applied), Water policy, Water shortage, Water supply, Water utilization, Public health, Standards, Administration, Social aspects, Long-term planning, Future planning (Projected), Coordination, Governments, Programs.

In the past, water resources development has been based on expediency, as water quantity was the primary concern of water users. However, the importance of water quality in water resources development is now being recognized. Moreover, in order to avoid irreparable damage to our water resources, rational and comprehensive water resources planning and management must be utilized. In planning for the maximum use of water resources which are consistent with their maintenance and protection, consideration should be given to the interrelationship between water development and usage and water quality because changes in one aspect of a water resources system may have far-reaching consequences in other areas of water use. Therefore, there is a need for a comprehensive water planning program which would be based on a defined water system and which would consider the relationships of all water uses in such system. Furthermore, it is imperative that the planning agency develop broadly based programs in such a manner as to coordinate planning at all levels of government. This overall planning is essential in order to insure an adequate supply of quality water for the future. (Finman-Florida) W70-09056

APPLICATION OF SPECIALIZED OPTIMIZA-TION TECHNIQUES FOR WATER QUALITY AND QUANTITY MANAGEMENT WITH AND QUANTITY MANAGEMENT WITH RESPECT TO PLANNING FOR THE TRINITY RIVER BASIN, Texas A and M Univ., College Station. Water

Resources Inst.

W. L. Meier, Jr., and C. S. Shih.

Available from NTIS as PB-193 684, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Institute, Technical Report 30, July 1970, 115 p, 11 tab, 20 fig, 40 ref. OWRR Project B-024-TEX

Descriptors: *Optimization, Water resources planning, Water quality, Management, Dynamic programming, Operations research, *Systems analysis, *Waste water treatment, *Water treatment,

ysis, *Waste water treatment, *Water treatment, *Low flow augmentation, Texas.
Identifiers: Planning, Optimization, Management, Water quality, Systems analysis, Trinity River

Techniques are developed and presented forming the basis for the development of water manage-ment plans which include consideration of water ment plans which include consideration of water quality and quantity in the same model. The methodology described in this report utilizes a dynamic programming approach in devising the mix of waste treatment, water treatment, and low flow augmentation to minimize the total cost of developing and operating the system while being regulatory in aesthetic restrictions. Use of these arresolutes against the augmentation of the treatment. procedures permits the evaluating of the trade-off between costs for water and waste treatment and reservoir releases for quality control plus a consideration of the economic returns afforded b recreational use of the water. This investigation represents more of a systems approach to water quality management than the studies heretofor completed. Advances in the optimization of nor serial multistage systems are presented in the resolution of such systems. Example problems are in cluded illustrating the use of the techniques. (Meicer-Texas A and M) W70-09094

HEAT WASTE,

Rosenstiel School of Marine and Atmospherica Sciences, Miami, Fla. For primary bibliographic entry see Field 05B.

A CONTRIBUTION TOWARDS THE REDUCTION OF ICE FOG CAUSED BY HUMINISTACK GASES AT ALASKAN POWER STA TIONS. Glasgow Univ. (Scotland); and Dartmouth Coll.1

Hanover, N.H. Andrew Porteous, and Graham B. Wallis

Atmospheric Environment, Vol. 4, p 21-33, 1970.0

Descriptors: *Fog, *Ice, *Humidity, Gases, Thermal powerplants, Drying, Moisture uptake, Alaska, Design data, Ducts, Velocity, Drops (Fluids). Identifiers: *Ice fog, *Visibility problem.

The humid power station gases at U. S. Army and The humid power station gases at 0. 3. Army and Air Force Bases in Alaska can cause considerable ice fog visibility problems. The evaluation of various alternatives for drying the humid stack gases shows counter-current scrubbing to be a viable solution where plentiful water supplies exist. High moisture removal rates can be easily accomplished as shown by the experimental results. The good agreement between theory and experiment enables spray towers to be designed to cope with the dehumidification of stack gases. The completed scrubber for the conditions at a typical air base is then designed for a gas velocity of 2.1/m.sec, with an active contact height of 10 m, to handle a wet total of 246,000/kghr of flue gases. Consideration is given for optimum droplet size to accomplish both grit and moisture removal from the gases. (H-sieh-Vanderbilt)
W70-09172

THE OPTIMIZATION OF STORM-HOLDING TANKS: A PROBLEM OF WATER POLLUTION CONTROL, Stanford Univ., Calif.

Charles Albert Kohlhaas.

Charles Albert Rollinas.

Available from University Microfilms, Ann Arbor, Michigan, \$15.30 per copy or \$4.35 on microfilm. Ph.D. Dissertation, February, 1970, 321 p.

Descriptors: *Optimization, *Storm drains, *Economics, Soical aspects, Recreation, Mathematical models, Chlorination, Settling tanks, Infil-

Identifiers: *Storm sewage, *Combined sewers, *Storage tanks, Non-linear programming, Effluent tax, San Francisco Bay.

A literature review of the hydrology, quality, effect on the environment, and control technology of combined sewer overflows and overflows from sewers subject to heavy infiltration is made. An analysis of water pollution externalities and remedies for dealing with them, including the use of the effluent tax in particular, is given. The relationship between the pollution caused by stormsewage overflow and competing urban needs is inserting the property of the pollution of the po vestigated. Two mathematical programs for op-timizing control facilities form storm-sewage overflows are defined - one achieves economic efficiency by means of the effluent tax, the other incorporates water quality goals by means of stream standards. The stream standards program is applied to a practical problem of storm-sewage overflow in

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Water Quality Control—Group 5G

ast San Francisco Bay, California. Water quality egulations for controlling overflows are formuated and treatment processes based on the use of olding tanks are defined. The effect of a holding ank on input discharge, BOD, and coliform con-centrations is described. Graphs relating BOD load and average coliform concentration of holding tank ffluent to tank capacity are employed to size holdng tanks capable of meeting effluent standards. the mathematical program is solved as a separable on-linear program. Detention times needed to atisfy BOD limitations were more than adequate o meet limitations on coliform concentrations. For most cities the high cost of solutions to stormsewage overflow problems will prevent the implementation of control measures in the near future. An effluent tax may be used as a means of financing atternative recreation and as an incentive for implementation of control measures. Requirements concerning maximum coliform concentrations are best met by limitations on the minimum size of holding tanks. Optimization models capable of incorporating an almost infinite number of holding tanks and over 2,000 water quality requirements may be constructed. (Kohlhaas-Stanford) W70-09181

OPTIMAL RESOURCE ALLOCATION AND SOME TECHNIQUES OF OPTIMIZATION,

Purdue Univ., Lafayette, Ind. Edna T. Loehman.

Purdue University Doctor of Philosophy Thesis, Purdue Library, August, 1970. 186 pages, 18 fig, 2 tab, 4 ref. OWRR Project B-020-IND (2).

Descriptors: Mathematical models, *Resource allocation, Resource Development, *Optimization, *Water pollution, Treatment facilities, Waste disposal.

Identifiers: Second best behavioral model, Algorithms, Zero-one programming.

This thesis is a collection of papers dealing with op-timal allocation of water resources. The first paper discusses the problem of the Second Best. What is meant by 'second best' is made clear by using as examples two cases of market imperfection: monopoly and an externality due to water pollution. The second paper extends the modeling of a water pollution externality to a time-varying case. It is shown that restrictions on the polluter for op-timal resource allocation should vary with streamflow. The third paper presents algorithms and a computer program for zero-one integer programming. The algorithms are tree search methods where the search is guided by an associated linear programming problem. The last section of the thesis is a proposal for further work in the area of treatment plant financing and design. A bargaining model is proposed to determine location and capacity of a treatment facility given that bargaining participants have rights to use a certain proportion of the facility and must pay a certain proportion of fixed costs as well as price per unit of treatment. W70-09182

SPACE HEATING IN URBAN ENVIRON-

Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 08C.

USE OF TOPOLOGIC INFORMATION IN PROCESSING DATA FOR CHANNEL NET-WORKS.

IBM Watson Research Center, Yorktown Heights,

For primary bibliographic entry see Field 07C.

SOME EFFECTS OF FRESH-WATER INFLOW ON THE FLUSHING OF SOUTH SAN FRAN-CISCO BAY: A PRELIMINARY REPORT, Geological Survey, Washington, D.C.

D. S. McCulloch, D. H. Peterson, P. R. Carlson, and T. J. Conomos.

Available free on application to the U S Geological Survey, Washington, DC 20242. In: A Preliminary Study of the Effects of Water Circulation in the San Francisco Bay Estuary, U S Geological Survey Circular 637-A, p A1-A27, 1970. 27 p, 15 fig, append.

Descriptors: *Estuaries, *Water circulation, *Bays, *California, *Water quality, Nutrients, Sewage disposal, Water pollution sources, Path of pollutants, Water pollution control, Tides, Currents (Water), Discharge (Water). Identifiers: *San Francisco Bay.

Data are provided for those interested in optimum development of the San Francisco Bay estuary. A clear understanding of this estuary system is necessary for evaluating such things as the ability of the estuary to assimilate agricultural, municipal, and industrial waste products; the relation between the amount of freshwater inflow and the quality of the bay water; and the movement of water masses and entrained material within the estuary. The seasonal salinity variation of the south bay is largely controlled by fresh water from the Sacramento River under present conditions and is nearly unaffected by the comparatively minor discharge of south bay streams and sewage. The change in phosphate concentration corresponds with the seasonal change in the Sacramento River discharge. Apparently changes in net flow of fresh water to the bay from this source is an important controlling factor in flushing of the south bay. Soluble waste materials are removed from south bay largely during periods of high river discharge. (Knapp-USGS) w70-09215

NITRATE INSTALLATION FOR DRAIN

REDUCTION,
Agricultural Research Service, Brawley, Calif.
Southwestern Irrigation Field Station; Soil Conservation Service, Fresno, Calif.; and Bureau of Recla-mation, Sacramento, Calif. Land Resources

L. S. Willardson, B. D. Meek, L. B. Grass, G. L.

Dickey, and J. W. Bailey. Groundwater, Vol 8, No 4, p 11-13, July-August 1970. 3 p, 2 fig, 2 tab, 2 ref.

Descriptors: *Denitrification, *Biodegradation, *Nitrates, *Groundwater, *Drainage systems, Subsurface drainage, Drawdown, Water level fluctua-tions, Saturated flow, Unsaturated flow, Aeration. Identifiers: Groundwater denitrification.

A field experiment was installed near Firebaugh in the San Joaquin Valley of California to test sub-merged drains as a means of denitrification of groundwater. Laboratory and field experiments show that denitrification occurs in saturated soil where there is ample organic carbon available for bacterial metabolism. Denitrification and dilution of high nitrate groundwater were accomplished in the field study. (Knapp-USGS)
W70-09228

ENVIRONMENTAL QUALITY.

Council on Environmental Quality, Washington,

Report available for inspection in USGS-WRD Library, Wash, D C. For sale by Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price \$1.75 (paper copy). First Annual Report of the Council on Environmental Quality together with President's Message, transmitted to Congress August 1970. 326 p, 10 fig, 10 tab, 12 append. tab, 12 append.

Descriptors: *Environmental sanitation, *Water policy, *Governments, Waste disposal, Land use, Air pollution, Water pollution, Pesticides, Solid wastes, Population, Political aspects, Water resources development, Ecotypes, Waste treatment, Water quality control, Cost analysis. Identifiers: *Environmental quality, *Ecological problems. problems.

A comprehensive and useful statement is given of the principal environmental issues that confront the nation - water pollution, air pollution, inadver-tent modification of weather and climate, disposal of solid wastes, problems of land use, pesticides, and radiation. Prepared by the Presidents's Council on Environmental Quality and transmitted to the Congress August 10, 1970, the report describes the problems and issues which need to be attacked, but offers no overall solutions. Pressures on the environment are discussed in a chapter on population, economic growth, and resources. An important proposal is made for a national land use policy. In water pollution, the report urges an increase in funds for waste treatment; a program in one river basin to demonstrate concepts of water quality management; effective enforcement of water quality standards; a strong Federal policy to control thermal pollution; development of a policy for ocean disposal of wastes; creation of new methods to prevent, control and clean up oil spills; and intensified attacks on agricultural pollution. Costs to clean up the nation's water over the next 10 years will total \$10 billion. (Lang-USGS) W70-09347

EVALUATION PROCESSES IN WATER RESOURCES PLANNING.

American Water Resources Association, Urbana,

For primary bibliographic entry see Field 06B. W70-09369

PROCEEDINGS WORKSHIP ON MOSQUITO CONTROL IN NORTH CAROLINA,.
North Carolina Water Resources Research Inst.,

For primary bibliographic entry see Field 06G. W70-09421

THOMPSON V CITY OF PHILADELPHIA (DAMAGE CAUSED BY CITY MAINTAINED SEWAGE SYSTEM).

177 So 39-40 (Miss 1937).

Descriptors: *Mississippi, *Drainage systems, *Sewage disposal, *Compensation, domain, Damages, Drainage programs, Overflow, Judicial decisions, Legal spects, Sewage, Local governments, Natural streams, Public benefits, Riparian land, Riparian rights, Drainage effects, Drainage water, Water pollution sources, Watercourses (Legal).

Defendant city maintained a sewage system, part of which included a natural watercourse flowing through plaintiff's property. Plaintiff contended that such drainage through his land caused offensive odors, rendered the water unusable and caused the watercourse to overflow from time to time, thereby resulting in a reduction in the value of his property. Defendant contended that absent proof property. Defendant contended that absent proof of negligent construction and maintenance of said of negligent construction and maintenance of said system, it could not be held liable to plaintiff in damages. The court held that defendant was liable for any special and different damage suffered by plaintiff not common to the general public if it is the contraction and maintenance of the plaintiff not common to the general public if caused by the construction and maintenance of the system, whether properly constructed and maintained or not. Such liability was not dependent on negligence, but on the taking or damaging of private property. The judgment for defendant was reversed. (Price-Florida)
W70-09484

WATER QUALITY: A CONCERN FOR AGRICULTURAL ENGINEERS, Cooperative State Research Service, Washington,

Agricultural Engineering, Vol 51, No 6, June 1970. 359 p.

Descriptors: *Water management (Applied), Water quality control, Waste water treatment, Sewage effluents.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G-Water Quality Control

Identifiers: *New York State Health Department, Long Island.

The challenge facing agricultural engineers in the field of water management is to devise alternative methods of maintaining water quality within the agriculture industry before effluent charges are enacted for different phases of the production and processing operations. The author cites an example of Long Island duck growers who banded together to install waste treatment systems with the coopera-tion of the New York State Health Department. Although the duck growers financed the waste treatment facilities with their own funds, the government regulatory agency coordinated the operation to insure that they met state and national water quality standards. (Holmes-Rutgers) W70-09499

06. WATER RESOURCES **PLANNING**

6A. Techniques of Planning

WATER QUALITY PLANNING AND MANAGE-MENT (PLANNING ESSENTIAL TO INSURE WATER QUALITY), California State Water Resources Control Board,

For primary bibliographic entry see Field 05G. W70-09056

OPTIMIZATION OF WATER RESOURCES SYSTEMS BY THE GRADIENT PROJECTION AND THE CONJUGATE GRADIENT METHODS,

Kansas State Univ., Manhattan. Dept. of Industrial Engineering.

E. S. Lee, and S. Waziruddin

Available from NTIS as PB-193 682, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, (1970). 102 p, 12 tab, 24 fig, 24 ref, 2 append. OWRR Project C-1032 (Number 1962) (1).

Descriptors: *Modeling, *Optimal management, *Water resources, *Gradient projection method, *Conjugate gradient method, Dynamic programming.

The gradient projection and the cojugate gradient methods are applied to the optimization of complex water resources systems. The most important advantages of these approaches are that they can be used to solve nonlinear problems with a large used to solve nonlinear problems with a large number of inequality constraints. Furthermore, these techniques can handle water resources systems with complex topological structures such as nonserial or branching reservoirs. Four water resources models with different complexity are solved by these methods. The results show that the convergence rate is quite fast and only a small amount of computer time and computer memory amount of computer time and computer memory are needed to solve a fairly complex problem. These requirements on the computer time and computer memory are almost negligible compared to that required by the dynamic programming approach. (Lee-Kansas State)
W70-09092

APPLICATION OF SPECIALIZED OPTIMIZATION TECHNIQUES FOR WATER QUALITY AND QUANTITY MANAGEMENT WITH RESPECT TO PLANNING FOR THE TRINITY RIVER BASIN,
Texas A and M Univ., College Station. Water

Resources Inst

For primary bibliographic entry see Field 05G. W70-09094

METHODS OF COMPUTING MAXIMUM SOIL FREEZING DEPTH,

For primary bibliographic entry see Field 02C. W70-09104

INDIRECT METHOD FOR COMPUTING THE DURATION OF PRECIPITATION,

For primary bibliographic entry see Field 02B.

A MODEL OF WATER QUALITY MANAGE-MENT UNDER UNCERTAINTY,

Chicago Univ., Ili. Charles Upton.

Water Resources Research, Vol 6, No 3, p 690-699. June 1970, 10 p. 12 ref.

Descriptors: *Water pollution control, *Water management (Applied), *Streamflow forecasting, *Stochastic processes, Probability, Standards, Water quality, Waste water treatment, Model studies. dies, Statistical models, Mathematical models,

Systems analysis.
Identifiers: *Water quality management.

Although the problems of water quality management are usually analyzed in the context of non-stochastic models, such an analysis may be misleading because of the substantial stochastic elements in streamflow. The effects of variance in streamflow are considered in this paper. The analysis shows that the problems of uncertainty may be dealt with by selecting a critical value of streamflow and then by treating pollutants sufficiently so that if streamflow falls above (or below) that critical value the water quality standard will (or will not) be met. The greater the variance in streamflow, the lower the optimal critical value. Further, the level of treatment of pollutants is higher under uncertainty than it would be if there were no vari-ance in streamflow. (Knapp-USGS) W70-09109

TIME BIAS IN RECREATION BENEFIT ESTI-

MATES,
Battelle Memorial Inst., Columbus, Ohio, and
George Washington Univ., Washington, D.C. Natural Resources Policy Center.
Frank J. Cesario, and Jack L. Knetsch.
Water Resources Research, Vol 6, No 3, p 700704, June 1970. 5 p, 3 fig, 7 ref.

Descriptors: *Cost-benefit analysis, *Recreation, *Demand, *Water management (Applied), Economics, Economic justification, Decision making, Planning, Costs, Feasibility studies, Resource allocation, Water demand, Estimating. Identifiers: Recreation demand.

Indirect methods are generally necessary to mea sure outdoor recreation benefits. A widely proposed technique involves estimating demand schedules using travel cost data as a proxy for prices. A major problem involved with this method as it has been applied is a serious conservative bias in the estimates, owing to the improper accounting of the constraint imposed by time costs on recreational visits. The bias is examined and corrections are suggested that could improve the estimates. The degree of ultimate improvement seems to de-pend on better data and on an understanding of the trade-off function between time and cost outlays for this form of travel. (Knapp-USGS) W70-09110

STOCHASTIC MODELS IN HYDROLOGY,

Illinois Univ., Urbana.
Adrian E. Scheidegger.
Water Resources Research, Vol 6, No 3, p 750-755, June 1970. 6 p, 13 ref.

Descriptors: *Stochastic processes, *Statistical models, Probability, Mathematical models, Model studies, Mathematical studies, Statistics, Markov processes, Time series analysis. Identifiers: Stochastic models.

The stochastic models that can be used to represent growth and steady state phenomena in hydrology are reviewed. There are essentially two types of growth models possible; the cyclic growth model and the random configuration model. For steady

state phenomena (time series) we are general restricted to a Gaussian type of model with a without autocorrelation. Self-similarity model (fractional Brownian motion) lead to physically ε surd conditions if they are extrapolated to his frequencies. (Knapp-USGS) W70-09115

A TWO-STEP PROBABILISTIC MODEL (STORAGE RESERVOIR WITH CORRELATE INPUTS,

Toronto Univ. (Ontario).

V. Klemes.

Water Resources Research, Vol 6, No 3, p 75'5 767, June 1970. 12 p, 8 fig, 10 ref.

Descriptors: *Statistical models, *Reservoir yiels Probability, Streamflow forecasting, Reservor storage, Reservor operation, Safe yield, Stochasts processes, Mathematical models.

Identifiers: Reservoir yield forecasting, Reservo management.

Fragmentation of Moran's (Aust J Appl Sci 5:11) 1954) model and decomposition of its transition matrix into a release rule and an input compone are used to simplify the problem formulation for reservoirs with complex operating rules. The Lloy (J Hydrol 1:99, 1963) model may be derived directly from that of Moran by introducing two suc cessive transitions of one variable instead of a sir gle bivariate transition. Combined with Gould's (Inst Eng, Aust 33:405, 1961) concept of transitio probabilities, the suggested model is used to tak into account the correlation between monthly flows simultaneously with that between annual flows. (Knapp-USGS) W70-09116

OPTIMAL RESOURCE ALLOCATION AND SOME TECHNIQUES OF OPTIMIZATION, Purdue Univ., Lafayette, Ind.

For primary bibliographic entry see Field 05G. W70-09182

ECONOMICS OF CANNERY WASTE TREAT!

MENT, Water Resources Engineers, Inc., Walnut Creek Calif.

For primary bibliographic entry see Field 05D. W70-09338

BOD MASS BALANCE AND WATER QUALITY STANDARDS,

Rutgers - The State Univ., New Brunswick, N.J.! Water Resources Research Inst. For primary bibliographic entry see Field 05A. W70-09349

ON THE SYSTEMS APPROACH IN HYDROLO-

Purdue Univ., Lafayette, Ind. Dept. of Aeronautics, Astronautics, and Engineering Sciences. For primary bibliographic entry see Field 02A.

HYDROLOGICAL SERIES AS A BASIS FOR

WATER RESOURCES POLICY, Technische Hochschule, Munich (West Germany). W. Bechteler.

Bulletin International Association of Scientific Hydrology, Vol 15, No 2, p 7-10, June 1970. 4 p, 3 fig, 5 ref.

Descriptors: *Statistical methods, *Time series analysis, Data collections, Hydrologic data, Frequency analysis, Streamflow forecasting, Water policy, Water management (Applied), Water resources development. Identifiers: Hydrologic series.

A necessary basis for resolving many problems concerning water resources policy and hydrology is the

Evaluation Process—Group 6B

use of long, homogeneous records of stages and discharges. Although in many countries long records of water stages are available, unfortunately many series are of no use, due to mistakes, gaps, or inhomogeneities. Stage series may often show trends caused by changes of the elevation or character of the river-bed. Therefore it is absolutely necessary to test the homogeneity of each series before it is used for any further investigations. A test of homogeneity, in most cases, is only possible with the help of statistical methods. (Knapp-USGS) W70-09387

A SYSTEM APPROACH FOR THE STUDY AND CONTROL OF FACTORS AFFECTING WATER POLLUTION.

Mississippi State Univ., State College. Water Resources Research Inst.
For primary bibliographic entry see Field 05B.

W70-09422

6B. Evaluation Process

ELECTRIC POWER - IMPACT ON THE EN-VIRONMENT, California Public Utilities Commission.

John J. Doran, Jr.

Amer Power Conf, (Paper) Chicago, Ill, Apr 1970. 15 p, 1 fig, 2 tab.

Descriptors: *Electric power, Electric power production, Electric power demand, Electric power industry, *Aesthetics, Transmission lines, *Environment, Environmental engineering, *Planning, Nuclear powerplants, Thermal power-plants, California, Electric power rates, Land use, Public opinion, Landscaping, Air pollution. Identifiers: Electric utilities, *Site selection, Elec-

tric power surveys, Pollution control, Air pollution control, Underground cables.

The importance of environment in our country has resulted in delaying electric power construction, and some areas face a possible electric energy crisis. The impact of providing the needed electricity without unduly affecting the environment is a challenge. Governmental agencies and the public utili-ties, privately and publicly owned, must work cooperatively toward the necessary solution. The more important aspects concerning California's need for additional power generation are discussed. Growth rates for the next 20 yr. public concern on siting, environmental and aesthetic considerations, and underground distribution are reviewed. The challenge of the 1970's to the electric utilities and manufacturers and to the regulatory agencies will be their ability to meet the requirements of the public for an improved environment, including abundant, safe, and reliable electric service at reasonable costs. (USBR)

MAJOR ELECTRIC POWER FACILITIES AND THE ENVIRONMENT, Edison Electric Inst., N.Y.

For primary bibliographic entry see Field 06G. W70-09048

TIME BIAS IN RECREATION BENEFIT ESTI-

MATES, Battelle Memorial Inst., Columbus, Ohio, and George Washington Univ., Washington, D.C. Natural Resources Policy Center.

For primary bibliographic entry see Field 06A.

ON USING A TIME VARIABLE INFILTRATION WITH THE ISRAELSON BORDER IRRIGATION EQUATION, Saskatchewan Univ., Saskatoon. Dept. of Agricultural Experiments.

tural Engineering.
For primary bibliographic entry see Field 03F.
W70-09141

PLANNING OUR FUTURE WATER RESOURCES.

Water Resources Board, Reading (England). L. E. Taylor.

Chemistry and Industry, No. 21, May 23, 1970, p668-673, 1 tab, 3 ref.

Descriptors: *Water resources development, *Future planning (Projected), *Decision making, *Optimum development plans, Water demand, Feasi-bility studies, Water costs, Water storage, Reser-voir storage, Groundwater, Groundwater recharge, Desalination, Electrodialysis, Environmental effects, Recreation demand.

Identifiers: *England and Wales, Estuarial bar-

The British national problem in water resources is storage and distribution, as sufficient rain falls on the island to meet all likely needs for many years to come. It was estimated that 3000 MGD of new resources must be made available by 2001. For this purpose, the following proposals were discussed:
(1) Major groundwater developments in the south east of the country. An important factor is the extent to which recirculation takes place between the river and the aquifer. (2) Artificial recharge of aquifers. The Water Resources Board is investigating the possibility of augmenting the natural infiltration to the Bunter Sandstone by means of artificial recharge. (3) Estuarial barrages. Experts are now studying the ecological and biological implications of the use of Morecambe Bay to conserve water. (4) Trent research program. This program was to determine the various ways in which the river might be made suitable for supply purposes and to assess their economic viability. (5) Desalination. The cost is about 6 s/1000 gal, which is too expensive compared to about 2 s/1000 gal for freshwater sources. (Hsieh-Vanderbilt)

SOIL, WATER AND SUBURBIA.

Department of Agriculture, Washington, D.C.; and Department of Housing and Urban Development, Washington, D.C.

Report of the proceedings of the National Conference on Soil, Water and Suburbia, Superintendent of Documents, U. S. Government Printing Office, Washington, D.C., March 1968. 160 p, 106 fig, 67 ref.

Descriptors: *Urbanization, *Soil-water-plant relationships, *City planning, *Land development, *Soil engineering, *Multiple purpose projects, *Soil stabilization, *Land use, *Administration, *Watershed management, *Soil conservation, *Goldman Programmer Land reclamation *Soil management, Economics, Land reclamation,

Federal project policy.
Identifiers: *Water-soil management, *Land use policies, Suburban land, Multidisciplinary planning.

Papers by 27 authorities in various professions, presented at the National Conference on Soil, Water and Suburbia in Washington, D.C. on June 15-16, 1967, are included in this publication. Comments by prominent discussants are also included. The purpose of the conference was to: (1) examine soil and water problems and opportunities that occur as land shifts from rural to suburban and urban uses; (2) exchange information on sources and types of soil and water management assistance available to public officials, planners, developers and builders; (3) explore the economics of land use changes, devices for reserving land for recreation, methods for maintaining natural beauty and reducing land damage and water pollution in the urban development process, and research needs in these development process, and research needs in these fields; and (4) discuss opportunities for community action in local and regional planning, in improvement of existing public programs, and in establishing guidelines for future federal and state assistance. The broad subject areas covered in assistance. The broad subject areas covered in-cluded: Land in Transition; The Suburban Land Resource and Its Use; Knowledge in Transition; and Community Action. The papers discussed in-terrelationships between soil, water and people

from the standpoints of problem definition and the need and advantages of bringing peiple of various professions and responsibilities together to promote effective problem solving. Multidisciplinary approaches in planning, design, development and construction are emphasized. (Poertner) W70-09188

A METHOD FOR THE EVALUATION OF THE SYSTEM AND COST EFFECTIVENESS OF LARGE SEA WATER DISTILLATION PLANTS, Planning Research Corp., McLean, Va. For primary bibliographic entry see Field 03A.

THE IMPORTANCE OF WATER RELATED AC-TIVITIES AT STATE PARKS IN MISSISSIPPI,

Mississippi State Univ., State College. Water

Mississippi State Univ., State College. Water Resources Research Inst. D. C. Williams, Jr., and Donnie L. Daniel. Available from NTIS as PB-193 686, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Research Institute, State College, Mississippi, July, 1970. 70 p. OWRR Project A-033-MISS (1).

Descriptors: *Recreation, *Parks, Recreation facilities, Recreation demand, Mississippi, *Tour-

Identifiers: State parks, Recreation visitation, *Park management.

The State parks in Mississippi are developed around and oriented to the use of water and related resources. There is a need for information on the number of visitors to the parks and the relative importance of the different water related resources for park management and planning purposes. Total visitation at the parks was obtained by use of mechanical traffic counters. During the course of one year, over 112,000 visitors were interviewed to determine the nature of their activities at the parks. The data were analyzed to determine the relative importance of water related and major non-water related activities for the Park System as a whole and by park. The activeness of visitors in the different parks was also analyzed. W70-09259

EVALUATION PROCESSES IN WATER RESOURCES PLANNING.

American Water Resources Association, Urbana,

Publication sponsored by Office of Water Resources Research. Report of a research conference at Milwaukee, Wisconsin, June 16-20, 1970, William Whipple, Jr., Ernest A. Englebert, and Warren L. Trock, Editors, sponsored jointly by AWRA and University of Wisconsin, Milwaukee; 160 p, July 1970.

*Evaluation. *Economic efficiency, Benefits, Economics, Ecology, Costs, Economic justification, Urbanization, Decision making, Institutions, Natural resources, Flood plain insurance, Social aspects.

Identifiers: *Effects, *Environmental quality, *Multiple objective planning, Metropolitan area water resources, Urban water problems, Economics of water quality control.

This is the report of an interdisciplinary research conference on evaluation processes in water resource planning. Due to the interests of those participating, the major emphasis was on the sub-ject of multiple objective planning, which is about to be incorporated into Federal approaches by the Water Resources Council. Although the consensus of those present clearly approved of the main thrust of the new proposals, there were many conflicting views expressed both as to the basic significance of the change and as to how it might be implemented. The basic concept of the conference precluded formal papers or attribution of individual views; but the principal viewpoints are summarized in the conference report. Besides multiple objective

Field 06—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

planning, other subjects of major interest included the economics of water quality control, flood plain management and flood insurance, special problems of metropolitan water resources analysis, political and economic aspects, and environmental and aesthetic aspects of evaluation processes. (Whipple-Rutgers) W70-09369

CHAPTER 1: INTRODUCTION.

National Academy of Sciences-National Academy of Engineering, Washington, D.C. Environmental Studies Board.

In: Institutions for Effective Management of the Environment, Washington, D.C. National Academy of Sciences - National Academy of Engineering, January 1970. p 13-16.

Descriptors: *Environment, *Management, Administration, Planning, Monitoring, Education, Communication.

Identifiers: Early warning system, Quick-reaction field function, Quick-reaction analytic function.

A number of functions that must be accommodated if the United States is to have effective environmental management are outlined. They include: (1) Long Range Planning: Development of a longrange strategy for effective management, protection, and use of the environment; (2) Early Warning: It is necessary to develop a system by which possible environmental disasters as well as positive developments for the improvement of environmental quality can be predicted; (3) Monitoring: To understand how man is changing his environment, ways of measuring environmental quality need to be developed; (4) Quick-Reaction Field Function: There is a need to obtain critical data in environmental problem areas on a short-term scale; (5) Quick-Reaction Analytical Function: There is a need to bring together available information in a cogent and timely fashion for decision makers at various levels of government; (6) Education: There is a need for greater numbers of personnel professionally trained in environmental problems and public awareness and concern for the environment; and (7) Communication: Closely coupled to the educational function is the function of making information about the environment available to the public. (See also W70-08929) (Davis-Chicago) W70-09439

SEWERAGE, SOLID WASTE AND AIR POLLU-TION CONTROL PLANS, Palm Beach County

Palm Beach County Area Planning Board, West Palm Beach, Fla.
David B. Smith, William R. Sabis, and David H.

Scott

Available from NTIS as PB-191 553, \$3.00 in paper copy, \$0.65 in microfiche. Palm Beach County Area Planning Board, Engineers Project No 6914 Report, Feb 70. 148 p.

Descriptors: *Water supply, *Waste treatment, *Sewage systems, Solid wastes, *Water demand, Community development. Identifiers: Palm Beach County, Florida.

Part One of this study, which included an inventory of Paim Beach County's water resources, water supply systems, sewerage systems, solid wastes systems, and air pollution control systems, and the legal and administrative aspects of each, was completed and published in six volumes, in 1969. The present report (Part Two) gives, under one cover, a summary of the Part One information. The report also presents an analysis of the inventory results leading into the development of comprehensive plans. W70-09450

PRELIMINARY WA MANAGEMENT PLAN. WATER AND WASTE

Sacramento Regional Area Planning Commission,

For primary bibliographic entry see Field 05D.

A TEST OF FEDERAL WATER PROJECT EVALUATION PROCEDURES WITH EMPHA-SIS ON REGIONAL INCOME AND ENVIRON-MENTAL QUALITY: DETROIT TRENTON NAVIGATION CHANNEL, RIVER.

Michigan State Univ., East Lansing. Dept. of

Agricultural Economics.
For primary bibliographic entry see Field 03E.
W70-09497

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

BAY ISLAND DRAINAGE AND LEVEE DIST NO 1 V NUSSBAUM (OPERATION COSTS OF **PUMPING FACILITY).**

388 III 131, 56 NE2d 615-617 (1944).

Descriptors: *Illinois, *Drainage districts, *Pumping, *Administrative agencies, State governments, Costs, Drainage, Surface drainage, Drainage programs, Drainage systems, Pumping plants, Seepage, Surface waters, Controlled drainage, Legislation, Legal aspects, Judicial decisions, Mississippi River, Federal government, Structures, Pumps.

Plaintiff drainage district brought suit against the commissioners of a sub-district for the determinacommissioners of a sub-district for the determina-tion of the amount owed by defendants for its share of operating a pumping plant. Plaintiff contended that under Illinois statutes, costs of such operations were to be shared by adjoining drainage districts on a percentage basis determined by the amount of water each had pumped through the plant. Defendant argued that the federal government, under a plan designed to subsidize adjoining drainage districts with seepage problems, had paid a portion of the amount claimed by plaintiff. Defendant further contended that the percentage figure assigned by plaintiff was too high. Testimony was introduced showing the percentage figure quoted by plaintiff was in fact too high, and evidence concerning the government payments was excluded. A directed verdict for plaintiff was entered. In reversing the trial court, the Supreme Court of Illinois ruled that the question of the percentage should have been given to the jury and that the evidence of government subsidies was improperly excluded. (Barker-Placide) W70-09155

REQUIREMENTS AND COSTS OF ALTERNATIVE SYSTEMS FOR TREATING PEACH CAN-

Clemson Univ., S.C. Water Resources Research

Inst.
G. H. Liner, and J. M. Stepp.
Water Resources Research Institute, Report No.
15, p. 1-75, April 1970. 16 fig, 19 tab, 33 ref.
OWRR Project A-002-SC (15).

Descriptors: *Canneries (Peach), *Waste water treatment, *Cost comparisons, Spray irrigation, Oxidation lagoons, Aeration.

Waste water treatment disposal by small seasonal peach canneries was studied, including description of the relevant practices of nine South Carolina canneries in 1966. The technical requirements for oxidation lagoons, aerated lagoons and spray irriga-tion systems of waste-water disposal by peach can-neries of five sizes were studied. The costs of con-structing and operating each type and size of facili-ty under South Carolina conditions as of 1967 and ty under South Carolina conditions as of 1967 and the effect of land values upon comparative costs were investigated. Non-land costs per unit of output were lowest for spray irrigation systems for all sizes of canneries, but as assigned land costs were increased to a relatively high level most of the least-cost 'positions' were occupied by aerated lagoons. (Stepp-Clemson)
W70-09183

COST CALCULATING DESALTING PROCEDURES,

Southwest Research Inst., Houston, Tex.
For primary bibliographic entry see Field 03A. W70-09241

6D. Water Demand

CITY OF NEW YORK V NEW YORK WATER SERVICE CORP (CITY MAY ORDER AN IN CREASE IN WATER SUPPLY). For primary bibliographic entry see Field 03D. W70-09025

AND WASTE PRELIMINARY WAS MANAGEMENT PLAN. WATER

Sacramento Regional Area Planning Commission

For primary bibliographic entry see Field 05D. W70-09453

6E. Water Law and Institutions

BRITISH WATER POLLUTION CONTROL, For primary bibliographic entry see Field 05D. W70-09041

ACKERMAN V TOWNSHIP OF NORTH HUNTINGDON (MUNICIPAL AUTHORITY TO GRANT RIGHTS IN PRIVATELY OWNED SEWER LINE).

261 A2d 570-573 (Penn 1970).

Descriptors: *Pennsylvania, *Local governments, *Sewers, *Pipelines, Waste disposal, Municipal wastes, Domestic wastes, Disposal, Sewage disposal, Cities, Contracts, Legal aspects, Judicial decisions, Public rights, Sewage districts, decisions, Public rights, Sewage districts, Remedies, Assessments, Cost sharing, Construc-

Identifiers: *Injunction (Restraining).

Plaintiff developer brought action to enjoin defendant township and another developer from connecting into a sewer line which plaintiff constructed, pursuant to a contract with the township for his and other developments as part of an overall seven as disposal plan Africa the server of the serve sewage disposal plan. After the sewer line was completed, but before title passed to the township, the township authorized defendant developer to tap into the line. Plaintiff contended that defendant township had no authority to authorize defendant developer to make use of a sewer line to which the township had no title. Defendants argued that, since the sewer was part of an overall plan and since the permits for the line were issued to the township, the township was the owner of the line. The court held that, under the terms of the confract, title to the line was clearly in plaintiff. Therefore, defendant developer was without valid permission to transport sewage through the line. However, the court felt that injunctive relief was improper as it would cause more harm than the interest protected, and remanded the case to assess defendant developer for a proportionate share of the cost of the sewer line. (Liptak-Florida)

HONEBEIN V MONTICELLO (DEED TO LAKE FRONTAGE AS NOT EXTENDING OWNER-SHIP TO LAKE BED),

263 App Div 745, 31 NYS2d 532-534 (Sup Ct 1941).

Descriptors: *New York, *Ownership of beds, *Lake beds, *Boundaries (Property), Beds under water, Beds, Real property, Judicial decisions, Legal aspects, Lakes, Docks, Watercourses (Legal), Prescriptive rights, Remedies, Maintenance, Land, Local governments, Water law, Relative rights, Boundary disputes.

Identifiers: Adverse possession.

Plaintiff-grantee to lake front land contended that her deed gave her title to the center of the lake bed abutting her property. Defendant village denied plaintiff's contentions and claimed the deed to plaintiff's lake front land restricted her ownership to the edge of the lake. Defendant also claimed title to the disputed lake bed by adverse possession. The majority of the court held for defendant. The dissenting opinion would have upheld plaintiff's claim of ownership to the center of the lake bed by con-struction of law, as the description in plaintiff's deed did not expressly restrict her ownership to the edge of the lake nor was the title to the center of the watercourse expressly withheld. Moreover, the dissent stated that defendant's claim of adverse possession was negated by plaintiff's sufficient showing of possession to the lake bed by the maintenance of a dock over the lake waters. (Finman-W70-09054

BD OF EDUC V NORTH HEMPSTEAD (NO RIGHT TO DAMAGES FOR NATURAL FLOW OF SURFACE WATERS).

261 App Div 1102, 27 NYS2d 114-115 (Sup Ct

Descriptors: *New York, *Drainage systems, *Natural flow, *Surface runoff, Surface waters, Drainage engineering, Land, Culverts, Drainage, Contours, Legal aspects, Judicial decisions, Remedies, Damages, Cities, State governments, Overland flow, Pipe flow, Regulated flow, Discharge (Water), Pipes, Maintenance, Rain, Volume, Flow augmentation.

Plaintiff school district's land was naturally contoured so that surface waters flowed over such land into a culvert constructed by the state. Defendant town constructed a catch basin system near plaintiff's land for the drainage of rain and surface waters. Plaintiff sought to restrain defendant from discharging surface waters upon its land and sought damages to such land due to the construction and maintenance of the catch basin system. The appellate court stated that plaintiff had failed to show that defendant's catch basin system, in fact, caused an increased volume of water upon its property.

Furthermore, the court noted plaintiff's failure to
prove that defendant should have installed larger drain pipes to adequately drain surface waters. Moreover, while defendant might have been liable for an increased volume of surface waters flowing over plaintiff's land due to the construction and maintenance of the catch basin system, it would not be held liable in this case for the natural flow of surface waters over such land. (Finman-Florida)
W70-09055

HOPKINS V UPPER SCIOTO DRAINAGE AND CONSERVANCY DIST (NO DAMAGES FOR IMPROPER MAINTENANCE OF DRAINAGE DISTRICT'S WATERWAYS).
67 Ohio App 505, 37 NE2d 430-432 (1940).

Descriptors: *Ohio, *Drainage districts, *Water injury, *Drainage effects, Administration, Governments, State governments, Maintenance, Ditches, Obstruction to flow, Land, Crops, Drainage systems, Damages, Regulation, Legal aspects, Judial Maintenance, Damages, Regulation, Legal aspects, Judial Maintenance, Descriptions, Postators, Postato cial decisions, Remedies, Conservation, Potatoes, Political aspects, Management, Standards, Legisla-

Defendant drainage and conservancy district, a political subdivision of the state, was alleged to have been negligent in failing to maintain its waterways or ditches in such a manner as to allow the unobstructed flow of water in such district. Plaintiff private landowner sought damages for the destruction of his potato crop which allegedly resulted from defendant's negligent maintenance of its drainage system. Defendant denied its liability for plaintiff's damages. The court noted that defendant was on instrumentality of the state and, in the absence of a statutory provision to the contrary, such instrumentality was not to be held liable for

injuries incurred in connection with the exercise of its governmental functions. In view of the fact that the only applicable statutory provision provided that no damages would be allowed if not otherwise allowed in law and expressly prohibited the imposition of any liability for destruction of crops due to improper maintenance of a conservancy district's waterways or ditches, the court ruled that plaintiff was precluded from bringing the action, and dismissed the petition. (Finman-Florida)

VARNEY RIVER DRAINAGE DIST V SPIEDEL (ASSESSMENTS ON LAND HELD BY EQUITA-BLE TITLE).

152 SW2d 54-58 (Mo 1941).

Descriptors: *Missouri, *Federal government, *Assessments, *Land tenure, Legislation, Drainage districts, State governments, Regions, Local governments, Judicial decisions, Legal aspects, Taxes, Swamps, Land reclamation, Benefits, Economics, Real property, Patents, Proprietary power, United States, Public lands, Federal government. Identifiers: *Equitable title.

Plaintiff drainage district sought to collect delinquent drainage assessments on defendant's land for improvements made under authority of state law. Defendant contended the assessments against his land were void since the state had no authority to make them. On the basis of the Swamp Land Act of 1850 and a prior case, defendant argued that the United States held title to the land prior to 1933, when the improvements were made thereon. Defendant argued that the Act gave Missouri no legal title to the land which it could convey until it acquired patents to the area from the United States in 1933. Therefore, no tax could be imposed for improvements made on the property while it was legally owned by the United States. The court rejected defendant's contention and held that the Act gave the state of Missouri a beneficial interest in the swampland. When the state legislature donated the land to the counties, a patent from the county to subsequent owners conveyed an existing right, which carried legal title with it when it was officially determined that the swampland fell under the Act. The grantee acquired sufficient equitable title to be subject to assessments for improvements. (Hubener-Florida) W70-09058

SANDERS V ROSE (PROPERTY BOUNDARY AS AFFECTED BY CHANGE IN COURSE OF STREAM).

296 Ky 25, 176 SW2d 119-122 (1943).

Descriptors: *Kentucky, *Boundaries (Property), *Boundary disputes, *Channels, Legal aspects, Streams, Water law, Water rights, Routing, Judicial decisions, Land tenure, Real property, Prescriptive rights, Adjudication procedure, Avulsion, Relative

Plaintiff and defendant owned adjoining farms, the boundary line between the farms being formed by a creek. A sudden change in the creek's course had moved the thread of the creek approximately 500 feet. Plaintiff sued to quiet title to the land between the old and new locations of the creek, contending that all the deeds in plaintiff's and defendant's that all the deeds in plaintiff's and defendant's chain of title, which established the property line at the creek, referred to the location of the creek prior to the sudden change. Defendant counterclaimed, asking that her title be quieted, and controlled that the dead to her fetter approximately the dead to her fetter approximately that the dead to her fetter approximately tended that the deed to her father referred to the creek at its new location. On appeal from a judgement for defendant, the court held that the weight of the evidence showed that all of the deeds referred to the channel of the creek as it was prior to the sudden change. The court noted that even if, as the chancellor had found, the deed to defendant's father referred to the creek's new location, defendant would have had to claim adverse posses sion for the statutory period in order to perfect her title. (Liptak-Florida)

W70-09059

DICKSON V SANDEFUR (DISPUTED OWNER-SHIP OF LAND APPEARING AFTER SUDDEN SHIFT IN RIVER'S COURSE). 235 So 2d 579-593 (La Ct App 1970).

Descriptors: *Louisiana, *Avulsion, *Accretion (Legal aspects), *Boundary disputes, Boundaries (Property), Floods, Bank erosion, Land tenure, Real property, Judicial decisions, Legal aspects, Navigable rivers, Sedimentation, River flow, Alluvium, River beds, Soil, River basins, Channel erosion, Channel morphology, Riparian land. Identifiers: *Re-emergence of lands.

Plaintiff and defendant owned land on opposite sides of a bend in the Red River. After a heavy spring flood the river changed its course. Plaintiff brought a possessory action claiming ownership of land on his side of the river which had appeared after the sudden cutoff by the river. The court gave judgment for plaintiff. Defendant filed a reconventional petitory action claiming ownership of land over which the river had formerly flowed further along the bend. Defendant claimed the land pursuant to a state statute providing that where a river opens a new bed owners of soil newly occupied by the river shall take the former bed. Defendant alleged that the land had appeared by an avulsive action of the river. The court held that defendant failed to sustain the burden of proof in establishing that an avulsive action occurred in the area he claimed. The court found that the land in question had been created by accretion to the opposite bank and such deposit belonged to the owners of those banks. Since the land was found to be the result of accretion, the court also rejected defendant's contention that the lands were subject to the doctrine of re-emergence of land after submergence. (Hubener-Florida) W70-09060

DALY V NEW YORK (DAMAGES TO CROPS FROM BARGE CANAL CONSTRUCTION).

262 App Div 661, 30 NYS2d 717-720 (1941).

Descriptors: *New York, *New York State Barge Canal, *Flood damage, *Crops, Damages, Flood-ing, Canals, Surface water, Canal construction, Potatoes, Agriculture, Land use, Judicial decisions, Legal aspects, Water law, Governments, Floods, Floodwater, Water injury, Overflow, Dams, Valleys, Remedies.

Plaintiffs, landowners along a creek which was part of the New York State Barge Canal, brought an action for damages caused by flooding of their lands. Plaintiffs claimed that due to the construction and operation of the Canal, their lands were flooded and their potato crops severely damaged. Defendant claimed that similar damage had occurred prior to the building of the Canal and that the damage complained of was not caused by the Canal. The Supreme Court of New York, Appellate Division, ruled that the evidence was sufficient to show that the flooding was caused by the Canal and that therefore the state was liable for the damage. The judgment of the trial court was affirmed. (Barker-Florida) W70-09061

IN RE EAST RIVER DRIVE (VALUATION OF SCENIC EASEMENTS IN CONDEMNATION PROCEEDINGS). 264 App Div 555, 35 NYS2d 990-1001 (1942).

Descriptors: *New York, *Condemnation value, *Eminent domain, *Scenic easements, Condemnation, Easements, Legal aspects, Right-of-way, Compensation, Water law, Judicial decisions, Local governments, Riparian rights, Access routes, Proportic Personal Proportic Page 2016 Real property, Remedies, Property values, Roads, Highways, Embankments, Bridges, Roadbanks, Retaining walls, Concrete structures, Zoning.

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Plaintiff city instituted condemnation proceedings to obtain river frontage for construction of a concrete, triple-deck viaduct. Defendant coal yard operator, who owned land located along the river, received damages for land taken, riparian rights and destruction of improvements, but contended that he was also entitled to consequential damages to the residue because the land was no longer suitable for apartments, which was conceded to be the 'best use' of the land, the viaduct having obstructed the view of the river. Co-defendant apartment owner received damages for the destruction of his riparian rights and consequential damages for obstruction of his easement of view, but contended that the consequential damages were inadequate. Plaintiff contended that, as to the coal yard, there was no damage to the improvements since a coal yard was an inadequate use of property zoned for apartments. As to the defendant apartment owner, plaintiff contended that there was no consequential damage since none of the apartment owner's property was taken. The court held, as to defendant coal yard operator, that damages were proper where the present business use was destroyed, notwithstanding that such use was not the best use of the property. As to defendant apartment owner, the court held that real property included easements and riparian rights and that a taking thereof necessitated consequential damages. (Liptak-Florida) W70-09062

NIAGARA FALLS POWER CO V DURYEA (RIGHT OF STATE TO CHARGE FOR WATER USE). 57 NYS 2d 777-787 (Sup Ct 1945).

Descriptors: *New York, *Hydroelectric power, *Public rights, *Preferences (Water rights), Relative rights, Water rights, Riparian rights, Water utilization, Diversion, Navigable rivers, Water policy, Legislation, Water resources, Water costs, Electric power industry, Administrative agencies, Competing uses, Judicial decisions, Legal aspects, Eminent domain, Beds under water, Ownership of beds, Governments.

Plaintiff power company brought suit against the Water Power and Control Commission of New York to have a statute nullified. The statute imposed a rental on water rights which plaintiff claimed as a previously acquired vested property right. Through a series of earlier statutes, plaintiff had been granted the rights to divert water from the Niagara River and now claimed that the Commission could not charge for such rights. Defendant claimed the right to charge rental for the diverted waters through the power of the state over naviga-ble public waters. The Supreme Court of New York found that the Niagara River was a natural resource of the state and that the state had the power to preserve to the public the energy of the river regardless of any rights in private interests it may have previously created or allowed. The statute was designed expressly for the preservation of the public rights to the water, and thus the state could validly charge for diversion thereof. (Barker-Florida) W70-09063

JAMES V DRAVO CONTRACTING CO (STATE'S RIGHT TO TAX FEDERAL GOVERNMENT'S CONTRACTORS). 302 US 134, 58 S Ct 208-233 (1937).

Descriptors: *West Virginia, *Taxes, *Dam construction, *Federal government, Damsites, Federal reclamation law, Federal jurisdiction, State jurisdiction, Legislation, Permits, Regulation, Judicial decisions, Governments, State governments, Legal expects Cartestee National Constructions of the Construction of the Construction of the Construction of the Cartest National Constructi Legal aspects, Contracts, Navigable rivers, Owner-ship of beds, Jurisdiction, Navigation.

West Virginia imposed a tax upon the gross receipts of respondent contractor for construction work done for the United States on dams and locks of a navigable river in West Virginia. Respondent brought suit to restrain the tax. The district court granted a permanent injunction against the tax. On appeal the United States Supreme Court held the questions presented were: (1) whether the state had territorial jurisdiction to impose the tax; (2) whether the tax placed an invalid burden on the federal government. The Court held that West Virginia could not impose a tax on work done by respondent outside of the state. Also, no tax could be imposed on work on any West Virginia site over which the United States retained exclusive jurisdiction. Exclusive jurisdiction did not mean the paramount authority of the United States over certain lands and rivers to provide for navigational or other improvements. The Court determined that the United States had not retained exclusive jurisdiction over the damsites in question. Since the tax was not imposed upon a government instrumentality, it did not present an intolerable burden. Therefore, the Court reversed the district court and upheld the tax. (Hubener-Florida) W70-09064

HINDERLIDER V LA PLATA RIVER AND CHERRY CREEK DITCH CO (EQUITABLE AP-PORTIONMENT OF INTERSTATE STREAM THROUGH USE OF INTERSTATE COMPACT). 304 US 92, 58 S Ct 803-811 (1938).

Descriptors: *Equitable apportionment, *Interstate rivers, *Interstate compacts, *Prior appropriation, Appropriation, Diversion, Beneficial use, Proration, Streams, Adjudication procedure, Water rights, Water law, Judicial decisions, Water allocarights, water law, Judicial decisions, water anotation (Policy), Federal jurisdiction, State jurisdiction, Irrigation water, Non-navigable streams, Priorities, Preferences (Water rights), State governments, Federal government, Water policy, Legal aspects, Relative rights.

Identifiers: *Injuction (Mandatory).

Plaintiff Colorado ditch company sought a mandatory injunction to restrain defendant state engineer of Colorado from depriving plaintiff of water used for irrigation. Plaintiff contended that its right to appropriate the water from an interstate stream had been established in prior state proceedings. Defendant contended that his water management policy was governed not by the prior proceedings, but by a river compact made by Colorado and New Mexico and ratified by Congress. Reversing the state court decision for plaintiff, the Supreme Court of the United States held that water in interstate streams must be equitably apportioned between states. Therefore, the state court proceeding was not res judicata with respect to the water rights of citizens of Colorado, since the state could only apportion to its citizens rights which represented the state's equitable share of the water in the stream. The terms of the compact were binding upon all claimants to water rights in those states that were parties to the compact. (Liptak-Florida) W70-09065

ARIZONA V CALIFORNIA (RELA RIGHTS IN COLORADO RIVER WATER). (RELATIVE

298 US 558, 56 S Ct 848-855 (1936).

Descriptors: *Arizona, *California, *Appropriation, *Colorado River, Water rights, Prior appropriation, Equitable apportionment, Federal jurisdiction, Federal-State water rights, Conflicts, Legal aspects, Judicial decisions, Relative rights, State jurisdiction, Water law, Interstate rivers, Navigable rivers, Navigation, Adjudication procedure, Diversion, Preferences (Water rights). Identifiers: *Boulder Canyon Project Act.

Arizona filed a suit against California and all other states of the Colorado River Basin seeking: (1) that Arizona's equitable share of Colorado River water, Arizona's equitable share of Colorado River water, subject to diversion and use, be fixed by the Court;

(2) that California be barred from claiming and using more than an equitable share of the river water not to exceed the limit imposed by the Boulder Canyon Project Act; (3) a decree that

diversion and use of any of Arizona's share by a del fendant state did not confer an appropriative right on the diverting state; and (4) that Mexico's equitat-ble share be supplied from California's equitable share. The United States Supreme Court held than Arizona could not act to exempt available wate. from appropriation until such time as the other state might want to appropriate it. A justiciable controversy would be presented only if Arizona had present rights in the unappropriated water. The court dismissed the mineral propriated water. court dismissed the suit on the ground that the United States, which was not a party, had a paramount power to control the unappropriated waters for the purpose of improving navigation. The United States was an indispensable party iri whose absence the water could not be apportioned (Hubener-Florida) W70-09066

ICKES V FOX (INCREASED WATER RATES: IMPOSED CONTRARY TO LAW).

300 US 82, 57 S Ct 412-418 (1937).

Descriptors: *United States, *Federal reclamation: law, *Water rates, *Remedies, Water utilization, Water users, Costs, Water distribution (Applied),) Water rights, Administrative agencies, Federal jurisdiction, Irrigated land, Water contracts, Relative rights, Judicial decisions, Legal aspects, Beneficial use, Irrigation water, Construction, Federal government, Taxes, Washington, Adjudication procedure. Identifiers: *Injunction.

Plaintiff landowners created a water user associa-tion and included their lands within a reclamation project under the Reclamation Act of 1902. The association entered into a contract with the United States to provide construction of irrigation works pursuant to the Act. The amount of water used by each member was to be determined by the government based upon the beneficial use of the water to such land. An act of Congress was passed providing that no increase of construction charges would be made except by special agreement with a majority of the water users. To finance expansion of irrigation works, the government sought to increase the charges for the use of the water without such agreement. Plaintiff landowners brought suit to enjoin the Secretary of the Interior from enforcing the increased water rates. Plaintiffs contended such increase would deprive them of their vested rights in the water. The federal government contended that it was an indispensable party whose sovereign im-munity had not been waived. The court held that the exemption of the United States from liability did not protect its officers in their individual capacity, and in the case of an injury threatened by the Secretary's illegal action, he could not claim immunity from the injunctive process. (Barnett-Florida) W70-09067

UNITED STATES V SPONENBARGER (ALLEGED TAKING OF PRIVATE PROPERTY WITHOUT JUST COMPENSATION VIA FLOOD CONTROL PLAN).

308 US 256, 60 S Ct 225-231 (1939).

Descriptors: *Arkansas, *Eminent domain, *Levees, *Floodways, Channel improvement, Flood control, Flood protection, Flood routing, Floodproofing, Flow control, River regulation, Routing, Water control, Diversion structures, Cutoffs, Flood damage, Spillways, Spillway crests, Watercourses (Legal), Mississippi River, Legislation, Judicial decisions, Legal aspects, Damages, Compensation.

Plaintiff brought action against the United States to recover compensation for the alleged taking of land resulting from the Mississippi Flood Control Act of 1928. Plaintiff's property was within a proposed floodway authorized by the Act. Plaintiff alleged that the mere fact the Act was in effect imposed a

Water Law and Institutions—Group 6E

ervitude on her land for the purpose of intentional uture flooding. Plaintiff further contended that her right of self-defense against floods through locally built levees was taken away the the 1928 Act. The Supreme Court, in holding for the United States, found that plaintiff's land was situated in the natural floodway of the Mississippi River and had not been subjected to any servitude from excessive floodwaters which had not already existed prior to 1928, and that her property had actually benefited by the government's impoundments. Furthermore, the mere possibility her land might be flooded, which possibility existed before the government's project, did not constitute the taking of private property without just compensation. The Court rejected the contention that the Act imposed a servitude for future flooding since the proposed flooding might never occur, especially since the construction of the floodway in question had been abandoned. Finally, the Court held that no right of self-defense against floods had been taken as the United States had not yet built or acquired levees as authorized by the Act. (Price-Florida) W70-09068

DANFORTH V UNITED STATES (COMPENSA-TION FOR TAKING OF PRIVATE PROPERTY). 308 US 271, 60 S Ct 231-237 (1939).

Descriptors: *Missouri, *Compensation, *Condemnation value, *Eminent domain, Condemnation, Right-fo-way, Federal jurisdiction, Federal government, Levees, Flood control, Easements, Mississippi River, Floodways, Drainage, Diversion, Diversion structures, Legislation, Spillways, Legal aspects, Judicial decisions.

Defendant landowner brought certiorari to review a district court and circuit court of appeals decision in favor of petitioner United States in a condemnation suit. Defendant had been awarded for land flooded by petitioner compensation less in amount than was agreed to by the parties prior to the suit. Moreover, defendant objected to the fact that no provision was made as to the interest to be paid thereon. The United States Supreme Court held that the amount agreed to by the parties was binding in that the offer had been accepted prior to the government's attempt to withdraw the offer. However, the time of the taking of the property is when compensation is paid unless taking occurs prior thereto in actuality or by statutory provision. Therefore, no interest had accrued on the amount agreed upon. The decree was affirmed in part and reversed in part. (Price-Florida) W70-09069

YEARSLEY V W A ROSS CONST CO (LIABILITY OF PRIVATE CORPORATION ACTING PURSUANT TO AN ACT OF CONGRESS). 309 US 18, 60 S Ct 413-415 (1940).

Descriptors: *Accelerated erosion, *Channel im-Descriptors: *Accelerated erosion, *Legislation, provement, *Compensation, *Legislation, Nebraska, Accretion (Legal aspects), Bank erosion, Erosion, Soil erosion, Damages, Alteration of flow, Navigable waters, Navigable rivers, Missouri River, Channel morphology, Dikes, Legal aspects, Judicial decisions, Riparian waters, Riparian land, Theorems of the compensation *Legislation, Federal government.

Defendant construction company had built dikes in the Missouri River and, using large boats with paddles and pumps, had produced artificial erosion of part of plaintiffs' land. Plaintiff landowners sought to recover damages. Defendant alleged that the work was done pursuant to contract with the United States government, as authorized by an act of Congress. Defendant further alleged that its actions had only hastened the inevitable and were done to improve the navigation of the river. Plaintiff contended that the contract did not contemplate the taking of property without just compensa-tion in violation of the fifth amendment. A decree for plaintiff was reversed in the circuit court. The Supreme Court held that since the act was done pursuant to an act of Congress, defendant could

incur no liability. If plaintiff's fifth amendment rights had been violated, the government had impliedly promised to pay, and a suit in the court of claims was the appropriate remedy. Plaintiffs' remedy was against the government, and not against its representative. The judgment of the circuit court was affirmed. (Price-Florida)

OKLAHOMA EX REL PHILLIPS V GUY F AT-KINSON CO (INJUNCTION AGAINST DAM CONSTRUCTION). 313 US 508, 61 S Ct 1050-1064 (1941).

Descriptors: *Oklahoma, *United States, *Dams, *Navigation, Eminent domain, Governments, Flood control, Damsites, Dam design, Maximum probable flood, Reservoirs, Water control, Multi-ple-purpose projects, Hydroelectric power, Economics, Navigable rivers, Mississippi River Basin, Regions, Interstate, Costs, Legislation, Judicial decisions, Legal aspects, Project planning, Relative rights. Identifiers: *Red River.

Oaklahoma brought a suit seeking to enjoin construction of a dam on the Red River by the United States. The state contended that the resulting reservoir would innundate a large tract of land and would thus interfere with existing public and private interests in the land. The state further claimed that the Red River was non-navigable in the proposed area, that Congress had no power over the water, and that the dam was a multiplepurpose project. Defendant argued that the dam was part of an overall scheme to protect the Mississippi River Basin, that the navigable portion of the Red River would be benefited and that the income derived from the sale of power from the dam operation would help finance the over-all project. The U. S. Supreme Court ruled that Congress has authority through the power over the waters of a river if any part of it is navigable and that the flood control program was part of the commerce power. The fact that ends other than flood control would result from an exercise of the commerce power would not invalidate that exercise. The injunction was denied. (Barker-Fla) W70-09071

PUERTO RICO V RUSSELL AND CO (IMPOSED TAX AS IMPAIRMENT OF CONTRACT FOR WATER SUPPLY).

315 US 610, 62 S Ct 784-791 (1942).

Descriptors: *Puerto Rico, *Contracts, *Taxes, *Supply contracts, Water delivery, Irrigation systems, Drainage districts, Riparian rights, Governments, Assessments, Costs, Operating costs, Dams, Relative rights, Water costs, Water supply, (Applied) Compating Water States Water distribution (Applied), Competing uses, Water rights, Judicial decisions, Legal aspects, Water policy, Water demand, Supervisory control Identifiers: *Constitutionality.

Puerto Rico brought an action to collect taxes imposed on lands of defendant, who was using water from a public irrigation system. When the dam which was part of the system was constructed, riparian owners below the dam site, whose lands were not within the drainage district, were offered contracts for delivery of water in return for their giving up their rights to the water to be used in the irrigation system. Defendant's predecessor has accepted such a contract, and defendant argued that if a tax were imposed on his land for the water use, the obligation of contract would be impared. Puerto Rico argued that the contract entered into was beyond the authority of the commissioner of the drainage district. The United States Supreme Court ruled that where a tax is imposed on land outside of a drainage district on water use stemming from a contract for delivery of such water in consideration of suspension of water rights, such a tax is an impairment of contract. It was also held that the com-

missioner was empowered by statute to make such contracts. (Barker-Fla) W70-09072

UNITED STATES V WILLOW RIVER POWER CO (IMPAIRED EFFICIENCY OF HYDROELECTRIC PLANT CAUSED BY RAIS-ING THE WATER LEVEL OF THE RIVER ON WHICH IT WAS LOCATED).

324 US 499, 65 S Ct 761-770 (1945).

Descriptors: *United States, *Hydroelectric plants, *Compensation, *Riparian rights, Public utilities, Condemnation value, Non-navigable waters, Eminent domain, Rivers, Judicial decisions, Legal aspects, Dams, Riparian land, Wisconsin, Electric power production, Power head, Navigable waters, Tailwater, High water mark, Federal government, Federal jurisdiction, Property values, Reasonable use, Ownership of beds, Usufructuary rights, Relative rights.

Plaintiff power company erected a dam on a Plainth power company elected a dain on a navigable river appurtenant to its riparian lands. The dam enabled the company to generate a greater power head. At a later date, defendant United States built a dam downstream from plaintiff for the purpose of aiding navigation. This dam increased the water level of the river and thus decreased plaintiff's power head. Plaintiff brought action to recover compensation for the impaired efficiency of its hydroelectric plant caused by de-fendant's actions. Plaintiff alleged that such action was a 'taking' of private property for which just compensation was required. The court of claims found the loss of power to be a property right for which a 'taking' by the government must be com-pensated. The United States Supreme Court reversed, and held that the fundamental principle of riparian rights is that each riparian proprietor has an equal right to make reasonable use of the waters. However, such right on a navigable stream is subject to a dominant public interest in navigation. Thus, in the instant case, no property right was taken, and no compensation was recoverable. (Barnett-Fla)

UNITED STATES V DICKINSON (EMINENT DOMAIN BY RAISING LEVEL OF RIVER PURSUANT TO CONSTRUCTION OF DAM). 152 F2d 865-871 (4th Cir 1946).

*Eminent domain, Descriptors: *Backwater, *Condemnation value, Erosion, Legal aspects, Engineering structures, Damages, Flood damage, Rivers, Navigable rivers, Riparian land, Navigation, Relative rights, Floods, Federal government, United States, Judicial decisions, Water levels, Compensation, Real property.

In an action for damages, plaintiff contended that the raising of the water level of a river by the construction of a dam had permanently submerged a portion of his land and had caused the remaining, unsubmerged land to be damaged by erosion so as to constitute a taking of property entitling plaintiff to compensation. Defendant federal government contended that the suit was barred by a statute of limitation and in the alternative admitted liability for the submerged land but contended that the damages to the unsubmerged land did not constitute a taking of property in that the damages were consequential resulting from the exercise of a paramount governmental power to improve navigation. The court held that the suit was not barred in that the action accrued when the water level was finally established and not when the level was initially raised. The court ruled that the defendant was liable for damages to the unsubmerged land in that when part of an owner's land is completely taken, he is entitled not only to compensation therefore but also to compensation for any damage occassioned to his remaining land. (Snow-Fla) W70-09074

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

DUKE POWER CO V TOMS (POWER COM-PANY'S RIGHT TO FLOOD ACCOMPANIED BY DUTY TO PAY DAMAGES). 118 F2d 443-449 (4th Cir 1941).

Descriptors: *North Carolina, *Easements, *Dam construction, *Compensation, Power operation and maintenance, Electric power, Electric powerplants, Damages, Construction, Flooding, Judicial decisions, Legal aspects, Maintenance, Floods, Remedies, Public utilities, Dams, River flow, Rivers, Obstruction to flow, Underground, Mining, Mineralogy, Flow, Eminent domain.

Defendant electric power company constructed a power dam which partially impounded the waters of a river. As a result, a portion of the lands in which plaintiffs held mineral rights became flooded. Plaintiffs claimed that this flooding had interfered with their right of access to the minerals below the surface, and that this amounted to the taking of property without just compensation. De-fendant asserted its right as a public service corporation to maintain its dam and flood the land in which plaintiffs claimed mineral interests. Plaintiffs brought action to quiet title to the lands in controversy. The court noted that this action was basically concerned with defendant's acquisition of an easement of flowage which interfered with plaintiffs' easement of access. The court held that as defendant was a public service corporation which enjoyed the right of eminent domain, it was entitled to maintain its dam and flood the lands in controversy, even though this might interfere with plaintiffs' right of access to the minerals contained below the surface of the lands. However, the court stated that plaintiffs had a right to any permanent damages which resulted from the flooding. (Fin-W70-09075

KUHN V CHESAPEAKE AND O RY (EFFECT OF CHANGE OF NATURAL WATERCOURSE ON PROPERTY BOUNDARIES).

118 F2d 400-405 (4th Cir 1941).

Descriptors: *Boundaries (Property), *Boundary disputes, *Channel flow, *Alteration of flow, Judicial decisions, Land tenure, Legal aspects, Natural flow doctrine, Proprietary power, Relative rights, Riparian land, Riparian rights, Riparian waters, Watercourses (Legal), Islands, Rivers, River flow, River beds, Channels, Streams, Deflection, Diversion.

The land in controversy consisted of about 9 acres which had formerly been an island between 2 branches of a river which, by deed from a common grantor, formed the boundary between plaintiff's and defendants' land. Neither party's deed contained a reference to the island. In the course of a flood, the right branch of the river filled with earth and debris and dried up. Both parties claimed title to the land which had formerly constituted the island. The trial court instructed the jury that the channel which they found to have been the main one before the flood would constitute the proper boundary. The circuit court of appeals reversed, stating that a determination of which of the channels was the main one was a significant factor to be considered by the jury in ascertaining the proper boundary, but it should not have been singled out as the sole factor for consideration. (Clarke-Fla) W70-09076

CARTER OIL CO V WATSON (BOUNDARY DISPUTE WHERE LAND CONVEYED BORDERED ON A STREAM). 116 F2d 195-198 (7th Cir 1940).

Descriptors: *Illinois, *Boundary disputes, *Boundaries (Property), *Ownership of beds, Judicial decisions, Legal aspects, Land tenure, Riparian land, River beds, Water law, Oil industry, Oil wells, Gases, Watercourses (Legal), Streams Streams

Plaintiff oil company sought to enjoin defendant from drilling for oil and gas on property to which both plaintiff and defendant claimed title. Plaintiff relied on a 1905 deed which he contended gave him title to the land to the middle of the creek adjacent thereto. Defendant contended the deed conveyed the property only to the bank of the creek. To avoid the well settled law that a grant of land bordering on a river carries with it title to the center of the stream, defendant relied on the working of his deed. He argued that the terms of the grant showed an intention to set the boundary at the stream's edge, especially since streams are often referred to in deeds as monuments and are regarded as such when the land conveyed abutts upon them. The appellate court held that, although the language of the deed was awkward, the intention of the parties was clear. The boundary line was the middle of the creek. Consideration of extrinsic evidence, along with the language of the deed, supported this conclusion. The lower court decision for the plaintiff was affirmed. (Price-Fla) W70-09077

BABCOCK V MISSISSIPPI RIVER POWER CO (INJURY TO LAND VIA DAM CONSTRUCTION).

113 F2d 398-400 (7th Cir 1940).

Descriptors: *Illinois, *Impounded waters, *Flood damage, *Compensation, Impoundments, Flooding, Cultivated lands, Drainage, Damages, Flood protection, Flow control, Floodwater, Floodways, Dams, Judicial decisions, Legal aspects, Land use, Legislation, Water distribution (Applied), Water spreading, Watershed management, Water storage, Water works, Mississippi River, Overflow.

Plaintiff landowner brought action against defendant power company to recover for flood and overflow damages which resulted from the erection of a dam, pursuant to an act of congress, across the Mississippi River. As a result of defendant's dam, part of plaintiff's land, which was leased for the purpose of farming, was rendered useless for cultivation. Plaintiff sought to recover only for recurring and intermittent damages. The court determined the cause of action stated by plaintiff resided only in the lessee of his lands. Plaintiff would have had a cause of action for permanent damages, but had not sought such. The granting of the motion to dismiss was affirmed. (Price-Fla)

FLORIDA BLUE RIDGE CORP V TENNESSEE ELECTRIC POWER CO (RELATIVE RIGHTS IN PROPERTY SUBJECT TO EASEMENTS), 106 F2d 912-916 (5th Cir 1939).

Descriptors: *Georgia, *Electric powerplants, *Easements, *Condemnation, Public utilities, Electric power, Electric power industry, Judicial decisions, Legal aspects, Right-of-way, Water utilization, Land tenure, Real property, Flow control, Industrial water, Land use, Lakes, Dams, Backwater, Water levels, Overflow.

Plaintiff corporation brought action against defendant power company to have flowage easements over plaintiff's land in Georgia declared abandoned and to obtain an injunction against trespass by defendant. Plaintiff contended that: (1) the original transfer of the easements to defendant by another corporation was void; (2) defendant, in acquiring the easements, had really acquired a franchise to sell electricity which was not transferable under public utility regulations; and (3) the easements had ceased when conveyed to defendant because they had been created by condemnation and the court held for defendant, stating that the transfer of the easements had complied with Georgia law. Further, the corporate charter gave the transferor the usual power to sell any or all of its property; this would include the easements in issue. The taking of the easement by condemnation was perpetual unless otherwise provided for, and compensation for lands overflowed was presumably paid. Moreover,

the state was the only proper party to attach this sale of the easement on the allegation that it suppressed competition in violation of public policy (Hubener-Fla) W70-09079

FRANKLIN V UNITED STATES (CONSEQUENTIAL DAMAGE FROM FEDERAL DIKE CONSTRUCTION IN IMPROVEMENT OF NAVIGAATION).

101 F2d 459-469 (6th Cir 1939).

Descriptors: *Dikes, *Alteration of flow, *Diversion, *Erosion, Barriers, Diversion structures: Flood control, Beds, River beds, Channel erosion Ownership of beds, Rivers, Mississippi Rivers. Navigable rivers, Judicial decisions, Navigation Bank erosion, Riparian land, Riparian rights, Obstruction to flow, Relative rights, Natural flows Federal government, United States.

Plaintiff riparian landowners brought action for damages, and contended that defendant United States, by the construction of a dike, had divertee the natural flow of the current of the Mississippi River and that as a result of such change of curren plaintiffs' lands were washed away. Plaintiffs further contended that such constituted a taking of lands for a public use so as to require compensation under the fifth amendment. Defendant contended that the diversion of the current by the dike was to improve navigation of a navigable river and was the exercise of a dominant right of the government in that regard, and as such there was no taking of property within the purview of the fifth amendment. The court held that defendant was not responsible to riparian owners for consequential damages from the deflection of waters by structures lawfully constructed in the aid of navigation. Such damages are not a taking of property in that there is no direct invasion of the riparian's lands, such lands being subordinate to the public right of navigation. (Snow-Fla) W 70-09080

PIKE RAPIDS POWER CO V MINNEAPOLIS STOP AND S S M RY (RELATIVE RIGHTS TO) RIVER BED AS BETWEEN BRIDGE OWNER AND DAM OWNER).

99 F2d 902-917 (8th Cir 1938).

Descriptors: *Ownership of beds, *Bridges, *Navigable waters, *Eminent domain, Dams, Relative rights, Navigable rivers, Rivers, River beds, Navigation, Riparian rights, Railroads, Damsites, Judicial decisions, Riparian land, Beds, Right-of-way, State jurisdiction, Land tenure, Federal government, Minnesota, Legal aspects, Condemnation, Compensation.

In an action to enjoin defendant railroad company from constructing a bridge over a navigable river, plaintiff power company contended that it, as a riparian landowner, had the riparian right to the use of the river bed upon which the bridge was to rest. Defendant, having been vested by state law with the power of eminent domain, converted the action into one for condemnation of plaintiff's lands and attendant riparian rights to the use of the beds. The question was whether or not the defendant had to compensate plaintiff for the property condemned. The defendant contended that by virtue of having obtained permission from the federal government to construct the bridge it had a superior right to the use of the beds and owed no compensation. The court held that the federal government's paramount right to regulate navigation rendered riparian rights in navigable rivers servient to the federal rights. However, the granting of permission to build a bridge was not an exercise of such plenary power. Thus, the taking of plaintiff's property and riparian rights through eminent domain required just compensation. (Snow-Fla) W70-09081 HOMAS B BISHOP CO V SANTA BARBARA COUNTY (MEANDER LINES AS BOUNDA-

6 F2d 198-203 (9th Cir 1938).

Descriptors: *California, *Boundaries (Property), Patents, *Meanders, Boundary disputes, Judicial ecisions, Legal aspects, Land tenure, Public enefits, Public rights, Seashores, High water mark, ow water mark, Sand pits, Surveys, Estimating, Mapping, Topography, Real property.

Plaintiff brought action in ejectment to recover and claimed to have been included in a patent to plaintiffs' predecessor by the United States. Defenlant county contended: (1) that the land was part of the public domain as it was not on the Surveyor General's plat, and (2) that the meander lines hereon constituted the boundaries of the land patented. Plaintiff asserted that the survey of the and included in the patent stated that the land was bounded by the seashore. The court stated that meander lines are not boundary lines. In reversing the trial court's judgment for defendant, the court held that the true boundary of the land patented was the seashore and not the meander lines as there was no evidence to affirmatively disclose an intention to limit the grant to actual traverse lines. Seaward projections from the survey lines con-stitute part of the patented land, and the land here involved was such a projection. (Price-Fla) W70-09082

VERDE RIVER IRRIGATION AND POWER DIST V SALT RIVER VALLEY WATER USERS' (CONTRACTUAL RIGHTS DAMSITE).

94 F2d 936-941 (9th Cir 1938).

Descriptors: *Arizona, *Damsites, *United States, *Relative rights, Dams, Dam construction, Reservoirs, Water supply, Ditches, Irrigation districts, Diversion, Water utilization, Water users, Hydroelectric power, Easements, Right-of-way, Surveys, Contracts, Grants, Judicial decisions, Legal aspects, Irrigation ditches.

Plaintiff irrigation district had been granted rightsof-way to build dams in certain locations along a river. Such grants required submission of maps of the proposed damsites to the Secretary of the Interior for approval. Plaintiff contended that a dam which defendant had contracted to erect was to be built on a site previously included in the grant to plaintiff, and therefore plaintiff sought validation of his easements and a voiding of defendant's contract. Defendant argued that no map of the disputed site was submitted to the Secretary of the Interior for approval, and therefore plaintiff had acquired no rights in the specific area. The Ninth Circuit Court of Appeals ruled that since no map of the exact location had been presented, the Secretary could not have approved the grant of that site to the plaintiff. Therefore plaintiff had acquired no rights in the location, and defendant's contract for dam construction was valid. (Barker-Fla) W70-09083

UNITED STATES V WABASHA-NELSON BRIDGE CO (COMPENSATION FOR CONSEQUENTIAL DAMAGES TO CONDEMNED RIGHT-OF-WAY).
83 F2d 852-856 (7th Cir 1936).

Descriptors: *Dams, *Right-of-way, *Water levels, *Condemnation value, United States, Condemnation, Engineering structures, Bridges, Rivers, Access Forties, Francoite, Project, domain, Local cess routes, Easements, Eminent domain, Legal aspects, Compensation, Federal government, Percolation, Capillary conductivity, Judicial decisions, Damages, River training, Navigable rivers, Mississippi River, Relative rights.

In a condemnation proceeding, plaintiff United States, pursuant to plans to construct a dam, sought to obtain flowage easements upstream. Defendant bridge company's right-of-way, a roadway embank-

ment leading to a bridge, was subject to such flowage easements in that the water level on the embankment would be raised. Defendant contended that the establishment of such an easement would constitute a taking of property and that the raised water level would, through percolation and capillary attraction, damage all of the roadway so as to entitle defendant to additional compensation. Plaintiff contended that it was liable only for the portion of the roadway actually invaded by the raised water level and that any other damages were merely consequential and thus not subject to compensation. The court held that where a portion of property is actually taken, the owner is entitled to compensation for the portion actually taken and for damages to the remainder of the land attendant to such taking. Thus defendant was entitled to compensation for damages to the entire roadway. (Snow-Fla) W70-09084

MCALLISTER V SLOAN (FLOODING OF PROPERTY DUE TO DAM CONSTRUCTION). 81 F2d 707-711 (8th Cir 1936).

Descriptors: *Arkansas, *Flood damage, *Damsites, *Dam construction, Adjudication procedure, Judicial decisions, Legal aspects, Riparian land, Riparian waters, Riparian rights, Federal jurisdiction, Backwater, Damages, Compensation, Real property, Water injury, Flooding.

Plaintiff landowners sought double damages for injury to their land by flooding which resulted from defendant's construction of a dam below their property. Defendant was granted a directed verdict in the trial court. The Circuit Court of Appeals, Eighth Circuit, reversed, holding that plaintiffs complaint had stated a common law cause of action for flooding of their lands, and that the complaint should not have been dismissed on mere technicalities. A new trial was ordered. (Price-Fla) W70-09085

NE-BO-SHONE ASS'N, INC V HOGARTH (PUBLIC FISHING RIGHTS IN NAVIGABLE

81 F2d 70-73 (6th Cir 1936).

Descriptors: *Michigan, *Fishing, *Public rights, *Navigable rivers, Rivers, Beds, River beds, Navigable waters, Navigation, Ownership of beds, Riparian rights, Relative rights, Boating, Judicial decisions, Recreation, Sport fishing, Legal aspects, Usufructuary right, Non-navigable waters.

Plaintiff, owner of property through which a river ran, brought an action to have his rights in such river established and to have an injunction issued to stop various members of the public from fishing upon such river. Plaintiff contended that the stream was not navigable and that the public thus had no rights in such river since he, as owner of the bed of the river, held exclusive rights to the river. Defendants contended that the river was of a public character and consequently there existed a right of the public to fish therein. The court found that the river, though not navigable as to boats, had previously ously been used to float logs, thus establishing the river as capable of being used for the purposes of commerce and thus qualifying such river as public waters. The court recognized that plaintiff was the purpose of the head of the river by writtee of hears the owner of the bed of the river by virtue of being the owner of the land which it traversed but held that if waters are public for any purpose, they are public for all purposes so as to establish a public fishing right in the river. (Snow-Fla)
W70-09086

PALM BEACH COUNTY V SOUTH FLORIDA CONSERVANCY DIST (DRAINAGE DISTRICT'S USE OF LEVEE FOR CONSERVATION PARAMOUNT TO COUNTY'S USE AS A PUBLIC ROAD).

170 So 630-633 (Fla 1936).

*Florida, *Drainage Descriptors: *Florida, *Drainage districts, *Levees, *Right-of-way, Roads, Local governments, Legislation, Prescriptive rights, Legal aspects, Judicial decisions, Water law, Public rights, Water resources development, Easements, Administrative agencies, Real property, Public lands, Land reclamation, Canals, Transportation, Water conservation, Canal embankments, State governments, Relative rights.

Plaintiff drainage district brought suit to enjoin de-fendant county commission from interfering with the reconstruction of a levee. Plaintiff had constructed the levee along a canal in 1917 and in 1921 it was leveled and used as a public road. When plaintiff began to raise the height of the levee, defendant had plaintiff's officers arrested and charged with obstructing a county highway. Although plaintiff had originally built the levee, defendant contended that state law provided that any road maintained by a county for four years shall be considered dedicated to the public. Plaintiff argued that reconstruction of the levee was necessary for proper drainage and reclamation. Affirming the trial court's judgment for plaintiff, the court held that the statute providing for dedication of roads after the statute providing for dedication of roads after the statutory period was not intended to divest public bodies, such as plaintiff drainage district, of rights-of-way acquired for public purposes in accordance with the law. Furthermore, the court pointed out that, while the road could be built elsewhere, the levee would be constructed in no other place. (Liptak-Fla) W70-09087

BROWN V NORTH ST LUCIE RIVER DRAINAGE DIST (DUTY OF LANDOWNERS TO MAINTAIN LATERALS CONNECTING TO DITCH OF DRAINAGE DISTRICT). 10 So 2d 910-913 (Fla 1943).

Descriptors: *Florida, *Drainage districts, *Laterals, Easements, Ditches, Locks, Relative rights, Legal aspects, Judicial decisions, Flow control of the co trol, Engineering structures, Drainage systems, Flood damage, Overflow, Local governments, Dikes, Dams, Flood control, Surface waters, Maintenance, Repairing. Identifiers: *Injunction.

Plaintiff landowners outside defendant drainage district were granted an easement by defendant to utilize the drainage ditches of the district provided owners properly maintained the laterals which would be constructed to tie in with the ditches. A lock constructed to control the flow of water from plaintiffs' ditches was damaged so that water flowed uncontrolled into the district causing flood damage. Defendant district threatened to construct a dam to cut off all flow from plaintiffs' ditches. Even though plaintiffs agreed to repair the lock, defendant began to build a dam. Plaintiffs' sought an injunction against construction of the dam. The lower court denied the injunction. The Florida supreme court held that the original contract granting the easement controlled the rights and responsibilities of the parties. The court modified the lower court decree so that plaintiffs would be able to renew their application when they could show they were maintaining the locks, laterals and ditches so as not to cause overflow or harm to lands in the drainage district. (Hubener-Fla) W70-09088

TROUT BROOK CO V WILLOW RIVER POWER CO (LIABILITY FOR DAM FAILURE DURING UNPRECEDENTED FLOOD).

267 NW 302-306 (Wis 1936).

Descriptors: *Wisconsin, *Dam failure, *Flood damage, *Maximum probable flood, Riparian rights, Riparian land, Water rights, Water law, Legal aspects, Judicial decisions, Damages, Remedies, Floods, Dams, Concrete dams, Earth dams, Mill dams, Flood control, Flood protection, Floodgates, Historic flood, Non-navigable waters,

Field 06-WATER RESOURCES PLANNING

Group 6E-Water Law and Institutions

Rivers, River flow, Hydroelectric plants, Trout, **Ponds**

Plaintiff riparian landowner brought action against defendant power company, alleging that defendant's negligent operation of its dams during a flood caused one of the dams to break, thereby damaging plaintiff's trout ponds. Plaintiff con-tended that defendant was required to provide for adequate passage of water through its dams at all times to prevent injury to riparian owners, and that the dams upstream from plaintiff's ponds would not have broken had defendant opened the flood gates sooner, as plaintiff had requested. Defendant contended that the flood was unprecedented, and that he was not required to guard against such unusual occurrances. Affirming a judgment for defendant, the court held that those who obstructed the flow of a stream were not required to guard against unusual and extradordinary floods which could not be reasonably anticipated. As to plaintiff's request to open the flood gates sooner, the court noted that defendant owed duties to upper as well as to lower riparian owners to maintain the flow of the river so as to do no damage to either upper or lower riparian owners. (Liptak-Fla)
W70-09089

WATER LAWS AND CONCEPTS,

Geological Survey, Washington, D.C.

Harold E. Thomas.

Available free on application to the US Geological Survey, Wash, DC 20242. US Geological Survey Circular 629, 1970. 18 p, 30 ref.

Descriptors: *Water law, *United States, *Water rights, Social aspects, Water utilization, Institutions, Governments, Legislation, Water management (Applied), Legal aspects, Water resources development. Identifiers: U.S. Water law

Throughout human history various laws and customs have developed concerning the individual rights and rights in common to the waters of the earth. Some laws and concepts have been carried by people in their migrations and colonial expansions to vastly different environments, with rather curious consequences. Some water laws that had been well adapted to the natural environment have become less tenable because of man's activities in modifying that environment, or because of increasing use of water. The water-rights systems in the United States vary from State to State: some are reasonably fitted to their environment, some have outlived their place in history, some are wasteful of water, some show favoritism to certain special in-terests or segments of the population. Water-use rights are universally recognized as real property, with constitutional protection against deprivation without due process of law. (Knapp-USGS) W70-09131

CITY OF NEW YORK V WILSON AND CO (EJECTMENT ACTION BY CITY SEEKING POSSESSION OF FILLED LANDS ORIGINALLY BELOW THE HIGH WATER MARK OF RIVER).

278 N Y 86, 15 NE2d 408-416 (1938).

Descriptors: *New York, *Landfills, *High water mark, *Boundaries (Property), Land tenure, Boundary disputes, Ownership of beds, Maps, Navigable rivers, Land use, Riparian rights, Docks, Judicial decisions, Legal aspects, Cities, Prescriptive rights, Leases, Beds under water, Condemnation, Access routes, Legislation, Appropriation, Local governments, Low water mark.

The City of New York brought an ejectment action against defendant, claiming that the land defendant occupied was below the original high water mark of the East River and that all land between the original high and low water marks of the River had been granted to the city in charters dating back to colonial times. The evidence showed the land in-

volved to have in fact been below the high water mark and to have been created by filling operations. The court held that such land was to be treated as land still under water, even after filling, and that the city still had title unless the defendant could show adverse possession. A statute passed in 1871 had made all lands under water belonging to the city inalienable. After this date, the court held, adverse possession could not run in favor of defendant. As defendant could not show adverse posses-sion prior to 1871, the city still had title to the land and was entitled to ejectment. The defendant was, however, held entitled to access to the river, as this was a riparian right attaching to certain upland held by defendant and which had not been affected by the 1871 statute. (Caldwell-Florida) W70-09142

MOHAWK CARPET MILLS, INC V NEW YORK (DAMAGES FROM FLOOD AND ICE JAM). 296 NY 609, 68 NE2d 885-886 (1946)

Descriptors: *New York, *Ice, *Ice jams, *Flood damage, Damages, Flooding, Flood protection, Ice breakup, Rivers, Ice loads, Canals, Channels, Bodies of water, Canal construction, Inland waterways, Canal design, Spoil banks, Legislation, Legal aspects, Judicial decisions, Boulders, Obstruction to flow, Alteration of flow, Natural flow doctrine, Explosives.

Plaintiff carpet mill brought action against defendant state seeking to recover for damages caused by a flood and ice jams in the Mohawk River and barge canal. Defendant had converted the river into a barge canal and in so doing had altered the channel by widening it, thereby creating spoil accumulation. An ice jam had backed up to plaintiff's property, and, when the river rose following upstream rain, the ice and flood water came onto the property, crushing a wall of the mill and doing other serious injury. Plaintiff argued that the state should have taken action, such as dynamiting the jam, in order to protect waterfront property. Defendant claimed that such jams had always freed themselves and that no action had appeared necessary to protect the property. In a per curiam decision, the New York Court of Appeals held the state liable for the damage caused by its failure to act. (Barker-Florida) W70-09157

SLIDE MOUNTAIN REALTY CO V STATE (CONDEMNATION VALUE OF A WATER BODY AND DAM), 306 NYS2d 519-528 (Ct Cl 1969).

Descriptors: *New York, *Condemnation, *Condemnation value, *Eminent domain, State governments, Adjudication procedure, Easements, Judicial decisions, Land tenure, Legal aspects, Ownership of beds, Proprietary power, Relative rights, Right of way, Remedies, Dams, Ponds, Spillways, Replacement costs, Estimating.

The dispute in this case arose from a condemnation proceeding concerning an award for the replacement cost of a dam, pond and spillway located on the condemned property. The appraiser for defendant state testified that he included the amount by which the pond, dam and spillway enhanced the value of plaintiff's property in his estimate of the fair market value before condemnation. Although plaintiff's appraiser did not value the pond, dam and spillway as an independent improvement, nevertheless he included as an item for damages \$49,500 over and above the value of the land alone, as a replacement cost for the pond, dam and spillway. The court found from the evidence that the estimate of defendant's appraiser was fair, and that the pond, dam and spillway did not contribute enhancement value sufficiently to warrant a separate award for the cost of their replacement. (Clarke-Florida) ANDERSON V HOBBS TIE AND TIMBER CO (TITLE TO BRIDGE RESTING UPON RIVER BED).

120 SW2d 158-160 (Ark 1938).

Descriptors: *Arkansas, *Ownership of bedd *Bridges, *Right-of-way, Structures, Railroads Beds, Beds under water, River beds, Judicial dec sions, Legal aspects, Riparian rights, Relativi rights, Rivers, Remedies, Easements. Identifiers: Injunctions (Prohibitory).

In a suit to enjoin the removal of a railroad bridg located in a river by the grantee of land adjacent the bridge, plaintiff asserted title to such bridge bl virtue of a right-of-way acquired by his predecessor in title. Defendant corporation intervened, and claimed title by virtue of a deed of conveyance of another tract of land adjacent to the bridge. The court found that the ends of the bridge had coblapsed into the water and rested upon the bed on the river. The court held that defendant had no been conveyed the bed of the river so as to preclude any claim it had to the title of the bridge Plaintiff's title, received from the owner of an ease ment for the railroad right of way on which the bridge was located was held to be superior. Consequently, since title to the bridge was in plaintiff an injunction prohibiting its removal was granted d (Snow-Florida) W70-09159

W A ROSS CONST CO V YEARSLEYY (GOVERNMENTAL LIABILITY FOR DAMAGES ARISING FROM IMPROVEMENT OF NAVIGATION).

103 F2d 589-593 (8th Cir 1939).

Descriptors: *Dikes, *Alteration of flow, *Erosion, *Navigation, River training, Navigable rivers, Riparian rights, Banks, Diversion, Judicial decisions, Relative rights, Riparian land, Damages, Accelerated erosion, Barriers, Rivers, River flow, Missouri River, Federal government, Eminent domain, Legal aspects, Compensation, Construction.

In an action for damages, plaintiffs contended that defendant construction company had constructed dikes in the Missouri River which deflected the current of the River causing plaintiffs' lands to be washed away. Defendant, agent of the United States under a contract to construct such dikes for the purpose of improving navigation, contended that the injury was not of a character which entitled the plaintiffs to compensation. Defendant argued that it had constructed such dikes pursuant to directions and supervision of the federal govern-ment. The court held that the United States, and thus its agent who had not exceeded the scope of its validly conferred authority, was not responsible to riparian owners for consequential damages from structures lawfully constructed in aid of navigation. Such consequential damages are not such a taking of property within the meaning of the fifth amendment as to require compensation. The riparian owner on navigable waters must bear the con-United States in the exercise of its dominant right in that regard. (Snow-Florida)

DANFORTH V UNITED STATES (CONDEMNATION VALUE OF EASEMENT FOR FLOOD CONTROL PURPOSES). 102 F2d 5-10 (8th Cir 1939).

Descriptors: *Condemnation, *Condemnation value, *Easements, *Federal jurisdiction, Flood control, Eminent domain, Legal aspects, Compensation, Judicial decisions, Mississippi River, Rivers, Federal government, United States, Riparian land, Contracts, Claims (Contract), Jurisdiction.

Pursuant to federal statute, defendant entered into a contract with the United States for an easement of flowage rights, for flood control purposes, over

Water Law and Institutions—Group 6E

defendant's lands. The United States repudiated the contract and brought a condemnation proceeding to obtain the easement. Defendant landowner contended that he was entitled to have his damages determined under the prior agreement. The United States contended that a federal court was limited in jurisdiction so as to be able to hear only the condemnation question and could not entertain a claim on the breach of contract. The court held that the doctrine of sovereign immunity precluded it from considering the contract claim. Thus, its only recourse was a consideration of the condemnation suit, and its determination of value of damages was to be made pursuant only to the statute authorizing such condemnation. (Snow-Florida) W70-09164

UNITED STATES V MCINTIRE (OWNERSHIP OF WATER RIGHTS ON INDIAN RESERVA-

101 F2d 650-654 (9th Cir 1939).

Descriptors: *United States, *Indian reservations, *Water utilization, *Irrigation programs, Relative rights, Water users, Water rights, Federal reservations, Public land, Legislation, Irrigation water, Beneficial use, Irrigation practices, Irrigation, Irrigation ditches, Irrigation systems, Appropriation, Prior appropriation, Priorities, Judicial decisions, Remedies, Legal aspects, Canals.

Plaintiff Indians brought suit to prohibit the acquisitions of certain water rights by defendant United States for use in an irrigation project. Plaintiffs claimed the rights through prior appropriation by their ancestor who had built an irrigation ditch on land which was part of the Indian reservation. Plaintiffs argued that such appropriation precluded interference with their right to exclusive use of the water. Defendant, who sought to construct a more complex irrigation system in the area, claimed that plaintiffs had not acquired any valid rights through their use of the water. The United States argued that the water rights in question had been reserved from the public land and that they could be transferred to a private company for the purpose of an irrigation project. The Circuit Court of Appeals, Ninth Circuit, ruled that the water rights had been reserved by federal statute and that the law protecting the use of water on public lands was not applicable. Therefore, the government could transfer the rights to the irrigation company since plaintiffs' ancestor had not acquired any exclusive rights to the water use. (Barker-Fla)

UNITED STATES V WALKER RIVER IRRIGA-TION DIST (RIGHT TO USE OF STREAM BASED ON PRIOR APPROPRIATION). 104 F2d 334-340 (9th Cir 1939).

Descriptors: *Prior appropriation, *Irrigation water, *Indian reservations, *Appropriation, Diversion, Natural flow, Water rights, Preferences (Water rights), Priorities, Riparian rights, Competitude of the competitude of (Water rights), Priorities, Riparian rights, Competing uses, Irrigation, Judicial decisions, Relative rights, Non-navigable waters, Streamflow, Streams, Federal jurisdiction, Irrigated land, Legal aspects, Flow federal reservations, Reservation doctrine.

The United States brought a suit to adjudicate relative rights in a non-navigable stream running through an Indian reservation and to restrain defendant appropriators of the waters from interfer-ing with the natural flow of the stream. The United States, acting on behalf of the Indians on the reservation, contended that the waters of the stream had been reserved to the extent necessary to supply the reservation with irrigation water when the reservation was created. Defendants, upstream riparian landowners and appropriators of the waters, contended that they had a paramount claim to rights in the stream by virtue of the fact that they were the first to actually divert and use the stream, even though the reservation had been established a year earlier. The appellate court held that there was an implied reservation of the flow of the stream for In-

dian use when the reservation was created and that such reservation of the stream by the federal government exempted the waters from subsequent appropriation. Thus defendants were enjoined from interfering with the natural flow of the stream. (Snow-Fla) W70-09174

BLASK V SOWL (OWNERSHIP OF ISLANDS IN NAVIGABLE WATERS). 309 F Supp 909-914 (W D Wisc 1967).

Descriptors: *Wisconsin, *Islands, *Boundary disputes, *Ownership of beds, River beds, Navigable rivers, Boundaries (Property), River flow, Accretion (Legal aspects), Reliction, Deposition (Sediments), Shores, Patents, Competition, Federal government, Water law, Riparian rights, State jurisdictions, Legal aspects, Judicial decisions, Mississippi River. Identifiers: *Island ownership.

Plaintiff successor in interest to patentee of shorelands brought an ejectment action against the Bu-reau of Sport Fisheries and Wildlife of the United States Department of Interior to obtain possession of a portion of an island in the Mississippi River. Under Wisconsin law, the owner of shorelands owns all land between the shore and the thread of a river. Plaintiff, who reserved all rights to the island between the shoreland he had deeded away and the thread of the river, relied on this law in his claim to the island. The district court held that state law regerding riparian rights on navigable waters does not apply to property owned by the United States. As regards navigable waters, the rights of the state reach to the waters and soil there-under, not to islands which rise above the surface of the water. United States patents can, with the assistance of state law, convey title to river-beds, but title to islands in navigable waters remains in the United States. Therefore plaintiff did not have title to the island since such title had never been taken out of the United States. (Price-Fla) W70-09175

UNITED STATES V ALASKA (RELATIVE RIGHTS IN SUBMERGED LAND).

423 F2d 764-768 (9th Cir 1970).

Descriptors: *Alaska, *Beds under water, *Ownership of beds, *Federal government, Lake beds, Federal-state water rights conflicts, Federal reservations, Withdrawn lands, Federal jurisdiction, State jurisdiction, Leases, Oil industry, Natural gas, Submerged Lands Act, Legislation, Wildlife conservation, Public lands, Wildlife habitats, Judicial decisions, Legal aspects.

The United States brought action to quiet title to lands under a lake in a certain Alaskan mountain range. In 1941 a presidential order made the range a wildlife refuge. In 1958 the Secretary of the Interior closed the southern half of the range to gas and oil leasing. However, in 1966 Alaska issued oil and gas leases to portions of the land beneath the lake. Defendant state and its lessees contended that under the general land laws of the United States, public lands did not include land under water. Defendants also claimed title to the land under water by application of the Submerged Lands Act. The court rejected defendants' contentions and held that the presidential order withdrawing and reserving for the Department of the Interior the disputed area of land and water was intended to include land under water, and thus the land did not pass to the state of Alaska on its admission to the Union. The general land laws of the United States and the Submerged Lands Act had no application to the disputed lands. The lands were set aside for a valid public purpose and the executive order could not be affected by Alaskan game laws. (Hubener-Florida) W70-09242

DAVIS V CITIES SERVICE OIL CO (LIABILITY FOR DAMAGES CAUSED BY OIL POLLUTION).

420 F2d 1278-1282 (10th Cir 1970).

Descriptors: *Oil, *Water pollution sources, *Overflow, *Damages, Pollutants, Water pollution, Path of pollutants, Soil contamination, Oil industry, Oil wastes, Oily water, Weirs, Rivers, Streams, Legal aspects, Remedies, Judicial decisions, Kan-

Plaintiff land owners and tenants brought action against various oil companies for damages allegedly caused by oil pollution. Defendants operated drilling fields and refineries along waterways that ran past plaintiffs' properties. It was contended that overflow from retention basins and seepage had entered the streams and damaged plaintiffs when the river overflowed its banks following rain storms. Defendants contended that the oil in question did not come from their operations, and they alleged that the source of the oil was not under their control. The trial court determined that plaintiffs' evidence was insufficient to prove liability on the part of defendants. The Court of Appeals for the Tenth Circuit ruled that such questions of fact were not reviewable and affirmed the judgment for defendants. (Barker-Florida) W70-09243

BURAS V ELLZEY (POSSESSORY RIGHTS IN WATERFRONT PROPERTY). 233 So 2d 586-589 (La Ct App 1970).

Descriptors: *Louisiana, *Land tenure, *Real property, *Boundaries (Property), Relative rights, Navigable waters, Riparian rights, Mississippi River, Surveys, Inspection, Legal aspects, Judicial decisions, Channel morphology, Beds, Ownership of beds, Beds under water, Meanders, Geomorphology, Boundary disputes.

Plaintiffs, record title holders to certain waterfront logs, brought action against defendants for alleged possession of the lots in 'bad faith.' Plaintiffs contended that the property was above water and that defendants were wrongfully in possession. Defendants alleged that plaintiffs' lots were now under water as a result of the shifting of the river, and that they therefore could not be in possession. Conflicting expert testimony of two surveyors was introduced. The trial court then ruled that plaintiffs' lots had become part of a navigable stream, and were, in fact, under water. On appeal, the court ruled that the trial court's acceptance of one survey was not clearly erroneous, and the judgement on behalf of defendants was affirmed. (Barker-Florida) W70-09323

BLISS V KINSEY (EXTENSION OF BOUNDARY LINES FROM MEANDER LINE TO SHORE LINE).

233 So 2d 191-194 (2d D.C.A. Fla 1970).

Descriptors: *Florida, *Boundary disputes, *Riparian lands, *Shores, Riparian rights, Boundaries (Property), Relative rights, Water rights, Equitable apportionment, Meanders, Shores, Accretion (Legal aspects), Judicial decisions, Legal aspects, Real property, Gulf of Mexico, Adjudication procedure. judication procedure. Identifiers: *Meander lines.

Plaintiff and defendant were adjoining land owners. The title description fixed the boundary of both lots on a meander line of the Gulf of Mexico. There was a strip of land between the meander line and the shore line to which the government had not retained title. The question was how to extend the boundary between the lots to the shore line. The lower court held that the boundary would be drawn and the land apportioned in the manner it would have been if the land between the meander line and the shore line had been created by accretion. The line was extended so as to provide each lot with the

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

same relative amount of shore line as it had on the meander line in the original survey. In affirming, the court recognized that although meander lines are not treated as boundaries, courts should at least approximate the amount of shore line as indicated on a meander line when called upon to establish actual boundaries. Where riparian rights are to be extended to the shore, all of the circumstances of the case should be considered. (Price-Florida) W70-09343

BRANT LAKE SHORES, INC V BARTON (ADVERSE POSSESSION OF LAND BELOW THE HIGH WATER MARK).

307 NYS2d 1005-1014 (Sup Ct 1970).

Descriptors: *New York, *Boundary disputes, *Ownership of beds, *Lake shores, Boundaries (Property), Easements, Leases, Legal aspects, Recreation, Relative rights, Riparian land, Riparian rights, Riparian water, Usufructuary right, Water rights, High water mark, Water level fluctuations, Watercourses (Legal), Low water mark, Beaches, Boating, Camping, Lakes, Lake beds, Recreational facilities, Judicial decisions, Prescriptive rights.

Plaintiff owned land adjacent to a lake, and claimed that, according to his deed, the boundaries of the property ran to the center of the lake. Defendant claimed that plaintiff owned only to the high water mark. An early deed in plaintiff's chain of title had set the lakeside boundary of plaintiff's lot at the high water mark. The next deed in the chain of title, however, and all deeds succeeding it, including plaintiff's, described the lakeside boundary of the lot as the low water mark. Plaintiff and his predecessors in title had openly and continuously used the beach and the waters of the lake, for commercial purposes in the form of boat rentals and camper's privileges, for over 40 years. The court held that a deed in a chain of title setting the boundary of lakeside property at the high water mark clouds any title claimed by the owner to the center of the lake. Only a boundary description set at the low water mark passes title to the center of the lake. In this case, however, plaintiff's use and possession of the waters of the lake and the beaches, unrebutted by the owners of the lake rights, constituted acquisition of title, by adverse possession, to the center of the lake. (Clarke-Florida)

CHAPTER 2: INSTITUTE FOR ANALYTICAL STUDIES.

National Academy of Sciences-National Academy of Engineering, Washington, D.C. Environmental

In: Institutions for Effective Management of the Environment, Washington, D.C. National Academy of Sciences - National Academy of Engineering, January 1970, p 17-28.

*Enviroment, *Management, Descriptors: *Planning, Institutions, Administration.
Identifiers: *Public policy, Early-warning capability, Interdisciplinary studies, Institute for Analytical

Of several institutions believed necessary to cope with the environment, one of the most important would be designed to: (1) Do the long-range planning necessary for restoring and protecting the quality of the environment; (2) Provide early warning of potential threats to the environment; (3) Conduct rapid analytic studies in response to emergencies, and; (4) Produce rapid field analysis. A number of considerations are suggested as necessary for a viable and effective institute for analytical studies: (1) Independence from the influence of any government agency or special interest; (2) Public availability of all studies; (3)Confidence of rubic availability of all studies; (3) Confidence of clients and the public in the integrity and independence of the institute; (4) Comprehensive representation of relevant disciplines; (5) A highly talented and dedicated professional staff; (6) A

group of experienced public-policy specialists and, on an ad hoc basis, consultation with administrators and elected officials; and (7) A policy of recruiting young people for positions of responsibility and influence. (See also W70-08929) (Davis-

CHAPTER 5: NATIONAL LABORATORY FOR

ENVIRONMENTAL SCIENCE.
National Academy of Sciences-National Academy of Engineering, Washington, D.C. Environmental Studies Board.

Washington, D.C., National Academy of Sciences -National Academy of Engineering, January 1970. p

*Environment, *Research and Descriptors: Development, *Research facilities, Forecasting, Management, Institutions.

Identifiers: *National Laboratory for Environmental Science, Environmental crisis, Quick-reaction field studies

It is recommended that a National Laboratory for Environmental Science be established. This National Laboratory for Environmental Science should be responsible for basic and applied research with the following objectives: (1) Analysis of the interaction of environmental factors, leading to; (2) Development of the capacity to predict environmental changes, and thus; (3) Development of the capability to maintain, modify, restore, improve, and generally manage the environment. An additional function of the laboratory will be to have the capability to carry out quick-reaction field studies pertinent to an environmental crisis. (See also W70-08929) (Davis-Chicago) W70-09443

CHAPTER 6: FEDERAL ORGANIZATION FOR MANAGING THE ENVIRONMENT.

National Academy of Sciences-National Academy of Engineering, Washington, D.C. Environmental Studies Board

Washington, D.C., National Academy of Sciences -National Academy of Engineering, January 1970, p

Descriptors: *Environment, *Management, *Institutions, Inter-agency cooperation, Institutional constraints, Planning, Administration, Legislation. Identifiers: *Board of environmental affairs, Environmental quality council, Policy.

It is felt that the Environmental Quality Council, a group of highest-level government officials supported by a part-time staff is an inadequate response to the problem of developing mechanisms for effective environmental management. The problem of reorganization of executive and congressional activities into a more closely coordinated effort are reviewed. It is recommended that reorganization should come about only after sophisticated management analysis, coupled with a realistic assessment of Executive-Congressional relationships. It is recommended that a Board of Environmental Affairs within the Office of the President be established. This Board should recommend and assist the President in formulating policies; evaluate programs and activities of departments and agencies and consider how they will affect the environment; analyze, interpret, and provide assistance in generating needed data concerning environmental matters; serve as a coordinator on a working level for interdepartmental activities relating to the environment; and assist state and local governments in dealing with environmental problems. Differences between the Board and the existing Environmental Quality Council are sum-marized. (See also W70-08929) (Davis-Chicago) W70-09444

IN RE CITY OF NEW YORK (RIGHTS OF OWNERS OF BEDS SUBSERVIENT TOUPLAND OWNER'S RIPARIAN RIGHTS).

158 Misc 684, 286 NYS 131-136 (Sup Ct 1936).

Descriptors: *New York, *Riparian rights, *Bedsiunder water, *Easements, Cities, Damages Remedies, Condemnation, Compensationn Eminent domain, Underwater, Land, Judicial decisions, Riparian waters, Riparian land, Reasonable use, Competing uses, Relative rights, Islands.s Ownership of beds, Usufructuary right, Lando

Defendant city brought condemnation proceedings to acquire plaintiff's underwater lands, which abutted on an island owned by defendant. These underwater lots had been partitioned by court decree and were distributed to plaintiff's predecessors in title. Plaintiff, therefore, contended that his underwater lands were not subject to the riparian rights of defendant upland owner. Moreover, plaintiff maintained that where underwater lands might: ordinarily be subject to an easement of the abutting upland owner, there was no easement in this situation by reason of the court decree of partition, which destroyed any easement or rights of defendant to these underwater lots. Defendant claimed that the law of the state was that an upland owner may not be prevented from exercising his riparian rights to the waters, and lands under such waters, adjacent to such upland. The court held that plaintiff's underwater lands, no matter how partitioned, were subject to defendant's riparian rights and easement. However, the court also noted that the existence of such easement did not deprive plaintiff of the right to damages which resulted from defendant's interference with the reasonable use by plaintiff of his lands. (Finman-Florida) W70-09457

UNITED STATES EX REL TVA V POWELSON (CONDEMNATION VALUATION). 319 US 266, 63 S Ct 1047-1061 (1943).

Descriptors: *United States, *Tennessee Valley Authority Project, *Condemnation *Eminent domain, Hydroelectric plants, value, Streams, Legislation, Condemnation, Judicial decisions, Legal aspects, Damages, Non-navigable waters, Land use, Market value, North Carolina, Relative rights, Compensation, Hydroelectric power, Evaluation, Land tenure, Land development, Administrative agencies, Public utilities.

Plaintiff private power company, which had been granted the power of eminent domain by North Carolina, had its land condemned for a TVA project. Plaintiff sought to place a very high value on the property, arguing that it could be combined with adjoining property condemnable by the com-pany to form a large hydroelectric project. The court rejected this contention because the condemnee's eminent domain power had not been exercised and was revocable by the state at any time. The chance of the condemnee being able to combine the necessary land to construct the hydroelectric project was considered too remote to affect the valuation of the land. The court held that the United States, in the absence of a specific statutory requirement, was not required to make compensation for the loss of a business opportunity based on the unexercised privilege to use the power of eminent domain. (Caldwell-Florida) W70-09459

COLORADO V KANSAS (APPORTIONMENT OF WATER BETWEEN UPRIVER AND DOWNRIVER STATES). 320 US 383, 65 S Ct 176-184 (1943).

Descriptors: *Kansas, *Colorado, *Interstate rivers, *Equitable apportionment, Natural flow doctrine, Riparian rights, Water utilization, Competing uses, Relative rights, Diversion, Reasonable use, Legal aspects, Judicial decisions, Water rights,

Water allocation (Policy), Water contracts, Irriga-ion, Beneficial uses, Water demand, Gradually varied flow, Irrigation water, Flow measurement.

Cansas had for some time claimed that Colorado nad appropriated so much water from the Arkansas River for irrigation in Colorado that severe injury was caused to downstream Kansas property. In an earlier action between the same parties, the Supreme Court had denied Kansas' contention that t was entitled to have the river flow as it did in its natural state. In that case, it was held that Colorado was not unreasonably diverting water from the river, and that any injury to Kansas property must be weighed against the benefits of irrigation to the area as a whole. In the instant case, Kansas argued that the use of the water in Colorado had increased to such an extent that the diversion unreasonably injured Kansas riparian land. The Court rejected this contention, reaffirming its holding in the earlier case, finding insufficient evidence of any drastic increase in Colorado water utilization. A recommended ruling by a special master, which would have awarded five-sixths of the water by acre-feet to Colorado and one-sixth to Kansas, was rejected. The Court held that the balance of interests had been struck in favor of Colorado in the previous case, and no reason for overturning that ruling had been presented. (Caldwell-Florida) W70-09460

NEBRASKA V WYOMING (APPORTIONMENT OF INTERSTATE WATERS UNDER PRIOR AP-PROPRIATION). 325 US 589, 65 S Ct 1332-1373 (1945).

Descriptors: *Equitable apportionment, *Interstate compacts, *Prior appropriation, *Natural flow doctrine, Wyoming, Nebraska, Colorado, United States, Water allocation (Policy), Federal government, Legal aspects, Legislation, Federal-state water rights conflicts, Relative rights, State governments, Unappropriated water, Water demand, Water supply, Water resources development, Interbasin transfers, Irrigation, Return flow, Reservoirs, Drought, Water storage.

The North Platte River, a non-navigable stream, originated in Colorado, flowed through Wyoming and Nebraska and emptied into the Missouri River near the Iowa border. A controversy arose concerning the use of the waters of the river for irrigation purposes. Nebraska claimed that the other two states were violating the rule of priority of appropriation in force in all three states, thereby depriving Nebraska of water to which it was equitably entitled. The Supreme Court adopted substantially the findings of the special master. The general holdings of the Court were: (1) the Desert Land Act made a non-navigable water supply on Land Act made a non-navigable water supply on public land free for private appropriation and separate from the land itself; (2) where several states recognizing the rule of prior appropriation are served by an interstate river, the rule of prior appropriation primarily will govern their relative rights as to the allocation of the water of the river, and such allocation must be based on the dependable flow, not the long-time average flow of the river; and (3) in such a situation, the court will allocate only the natural flow, not storage water, which is defined as water released from reservoirs; such storage water, however, may be considered in equitably apportioning the natural flow among the states involved. (Clarke-Florida)

BEARD'S ERIE BASIN V NEW YORK (RIGHTS TO COMPENSATION AWARD BASED ON OWNERSHIP OF LANDS CONDEMNED).

142 F2d 487-491 (2d Cir 1944).

Descriptors: *New York, *Condemnation, *Compensation, *Ownership of beds, Navigable waters, Eminent domain, Patents, Legislation, Grants, State governments, Riparian waters, Judicial deci-

sions, Legal aspects, Riparian land, Land tenure, Land use, Federal government, Landfills, Land forming, Relative rights.

The United States condemned certain land, part of which was under navigable waters. A dispute arose between plaintiff and defendant state as to their respective rights in the resulting condemnation award. Plaintiff contended it owned in fee all the land condemned by virtue of letters patent and legislative grants. Defendant contended that said documents were invalid, or in the alternative, if valid, that a possibility of reverter remained in the state so as to entitle it to a share of the award. The court held that plaintiff's grants and patents were valid, that under New York law the state was empowered to alienate lands under navigable waters to private parties and that once the conditions in the grants were met by the grantee the possibility of reverter in the state disappeared. Plaintiff was held to be the owner in fee simple of all the condemned land, and to be entitled to the full condemnation award. (Price-Florida) W70-09463

LONDON EXTENSION MINING CO V ELLIS (OWNERSHIP OF ACCRETED LANDS). 134 F2d 405-412 (10th Cir 1943).

Descriptors: *Colorado, *Accretion (Legal aspects), *Mine wastes, *Waste dumps, Legal aspects, Judicial decisions, Mining, Seepage, Riparian rights, Land forming, Land tenure, Real

In a case involving a contest over mining rights and ownership rights to a dump created by mining wastes and low grade ore, the court stated that when tailings are permitted to pass by stream or seepage onto another tract, they become an accretion to such tract and belong to the owner thereof. (Price-Florida) w70-09465

UNITED STATES V OTLEY (OWNERSHIP OF

LAKE BEDS). 127 F2d 988-1001 (9th Cir 1942).

Descriptors: *United States, *Boundary disputes, *Ownership of beds, *Meanders, Reservation doctrine, Oregon, Boundaries (Property), Federal government, Judicial decisions, Legal aspects, Land tenure, Proprietary power, Relative rights, Riparian land, Riparian rights, Watercourses (Legal), Lakes, Lake beds, Lake shores, Surveys, Real property.

By executive order, a non-navigable lake in Oregon was officially reserved as a federal sanctuary for migratory birds. Subsequent thereto the lake was surveyed and meandered by the General Land Office. Plaintiff United States then patented to defendants the fractional lots surrounding the lake. The official plat of said lands, as determined by the survey, was incorporated in the patents. Plaintiff sued to quiet title to the lake bed, contending that the meander line represented merely the boundary of defendants' upland, not the true shoreline of the lake, since the high water mark of the lake fluctuated so greatly. Defendants claimed title to the center of the lake as riparian landowners bordering a nonnavigable waterbody. The court held that where the amount of land between the surveyed meander line and the actual shore of the lake greatly exceeds the total area described in a patent to said land, the meander will not be considered that of the lake but a mere irregular boundary of the upland. A patent to such land would not transfer any title to land under the lake. In such a case, however, the heavy burden of proof is on the plaintiff to show that the meander line is not the approximate boundary of the lake, and here the United States failed to sustain that burden. (Clarke-Florida) W70-09467

CARTER OIL CO V DELWORTH (LESSEE OF LAND ABUTTING CREEK HAS RIGHT TO CREEK BED). 120 F2d 589-591 (7th Cir 1941).

Descriptors: *Illinois, *Streambeds, *Leases, *Drilling, Streams, Grants, Oil industry, Legal aspects, Judicial decisions, Real property, Land, Natural resources, Oil fields, Boundaries (Property), Rivers, Ownership of beds, State governments, State jurisdiction, Federal jurisdiction, Beds, River beds, Remedies, Relative rights. Identifiers: *Exclusive rights.

Plaintiff oil company's lessor was conveyed land abutting a creek. Subsequently, the same grantor leased the adjoining creek bed to defendants' assignor. These lands were acquired by plaintiff and defendants for the purpose of drilling for oil. Plaintiff brought suit to enjoin defendants' drilling in the creek bed, claiming the lease to the land abutting the creek entitled him to the exclusive right to drill the creek bed. Defendant contended that plaintiff's lease to the land bordering the creek did not include any rights to the creek bed. The court stated that, under state law, a grant of land bordering a creek or river gives the exclusive right and title to the center of the stream to the grantee, unless the grantor intended to reserve rights to the creek bed. The court did not read into plaintiff's lessor's deed any intended reservation of title to the creek bed, nor did the court find a reservation implied by the actions of the grantor. Therefore, in holding for plaintiff, the court recognized the rule that where there is no evidence of a contrary intent, the title to land bordering a stream extends to the center of such stream. (Finman-Florida) W70-09468

BERGER V OHLSON (NO ABSOLUTE RIGHT TO TOLL FREE USE OF GOVERNMENT CON-TROLLED DOCK).

120 F2d 56-60 (9th Cir 1941).

Descriptors: *Alaska, *Docks, *Payment, *Cities, Ships, Harbors, Railroads, Federal government, Federal jurisdiction, Public benefits, Construction, Judicial decisions, Legal aspects, Permits, Control, Royalties, Regulation, Standards, Land tenure, Relative rights, Use rates.

Identifiers: Tideland.

Plaintiff shipping company unloaded its large cargo ships by use of lighters or barges, which, in turn, carried the cargo to a city dock. Defendant railroad, which was owned and operated by the federal government, objected to plaintiff's lightering its cargo to the city dock since plaintiff was able to avoid wharfage fees exacted for the use of defendants. dant's dock. Therefore, in an effort to overcome plaintiff's competition, defendant demanded the payment of wharfage fees for plaintiff's use of the city dock. Plaintiff sought to enjoin defendant's demand of wharfage fees and interference with his use of the city dock. Plaintiff contended that the city owned the dock and that he was therefore privileged to use such dock as a member of the public without the payment of wharfage fees. De-fendant maintained that even though the city had built the dock, it was constructed on upland and tideland owned by the federal government, and was therefore subject to defendant's control. The court held that plaintiff had a mere license to the use of the city dock, and that defendant exercised its lawful authority by exacting a wharfage fee. (Finman-Florida) W70-09469

BROOKS V UNITED STATES (JURISDICTION OF FEDERAL COURT TO DETERMINE WATER RIGHTS IN INTERSTATE RIVER).

119 F2d 636-647 (9th Cir 1941).

Descriptors: *Federal jurisdiction, *Jurisdiction, *Interstate rivers, *Water users, Operating costs,

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Federal governments, United States, Arizona, New Mexico, Water supply, Water rights, Water management (Applied), Water distribution (Applied), Rivers, Water delivery, Water costs, Water control, Water allocation (Policy), Upstream, Remedies, Distribution systems, Legal aspects, Judicial decisions, Appropriation, River flow. Identifiers: *Contempt (Legal aspects).

Defendant upper water users, residents of New Mexico, were parties to proceedings brought by the United States in the federal district court of Arizona, which determined the rights of all water users to the waters of an interstate river which originated in New Mexico and flowed through Arizona. Defendants subsequently appropriated more water from the river than they were entitled to under the terms of the court's decree. In addition, defendants failed to pay their fair share of the operating costs of the distribution system set up by such decree. Therefore, plaintiff brought contempt proceedings against defendants for committing such acts in violation of the court decree. Defendants contended the court in Arizona did not have jurisdiction to determine the rights of water users in New Mexico, as a suit to adjudicate water rights was a local action. The court held defendants guilty of contempt, and stated that the Arizona court had jurisdiction to determine the rights of the upper water users in New Mexico to the interstate river insofar as such determination was directly related to the rights of the water users in Arizona. (Finman-Florida)

ALBION-IDAHO LAND CO V NAF IRRIGA-TION CO (PRORATION OF WATER RIGHTS UNDER PRIOR APPROPRIATION DOCTRINE).

97 F2d 439-445 (10th Cir 1938).

Descriptors: *Prior appropriation, *Priorities, *Proration, *Preferences (Water rights), Adjudication procedure, Judicial decisions, Jurisdiction, Federal jurisdiction, State jurisdiction, Streamflow, Streams, Non-navigable waters, Water rights, Appropriation, Beneficial use, Diversion, Legal aspects, Water law, Reasonable use, Remedies, Water allocation (Policy), Water loss, Intermittent streams

Identifiers: Injunction (Prohibitory).

Plaintiff lower landowners in Idaho sought an injunction restraining defendant upstream landowners in Utah from diverting water from an interstate non-navigable stream. On appeal from a judgment for defendants, plaintiffs, relying on prior decrees adjudicating their water rights, contended that the trial court had failed to apply the prior appropriation doctrine and had substituted a fair distribution of the water instead. Defendants asserted their own priorities in the beneficial use of the water and argued that a strict application of the prior appropriation rule resulted in waste when the streamflow was so diminished that the water would not reach the downstream prior appropriator in useful quantities. The court noted that prior appropriation applies to interstate streams where, as here, both states recognize the rule. As to the prior decrees, the court held that local actions to adjudicate water rights do not bind strangers to the judgment and do not determine water rights in another jurisdiction. The court then held that when, due to seepage, evaporation and other physical conditions, the water did not reach the prior appropriator was entitled to divert the water, thereby recognizing the priorities of the users, avoiding waste and making the best utilization of the water. (Liptak-Florida)

HOLYOKE WATER POWER CO V AM WRIT-ING PAPER CO (USE OF WATER POWER BEYOND SCOPE OF GRANT).

94 F2d 933-934 (1st Cir 1938).

Descriptors: *Massachusetts, *Electric power, *Water supply, *Water utilization, Water users, Mills, Grants, Electric power production, Electric generators, Water wheels, Non-consumptive use, Reasonable use, Transmission (Electrical), Industrial water, Industrial plants, Judicial decisions, Legal aspects. Identifiers: *Mill power.

Plaintiff water power company brought action to prevent defendant paper company's transfer of electric power from its mill sites to other locations. Defendant, as owner or lessee of certain mill sites whose water was supplied by plaintiff, had constructed electric generators on the sites which were powered by water wheels. The electric power created was transferred to other sites owned by defendant. Plaintiff argued that the original grant of the water supply restricted the use of the mill power to the specific site, and that defendant's operations were in violation of the grant. The First Circuit Court of Appeals ruled that the mill power was in fact being used on the specific sites, and that defendant's conversion of the mill power to electric current was not an improper use of the mill power within the meaning of the grant. The suit was dismissed. (Barker-Florida)

CONTINENTAL LAND CO V UNITED STATES (CONDEMNATION VALUE OF LANDS TO BE FLOODED BY A DAM).

88 F2d 104-111 (9th Cir 1937).

Descriptors: *Damsites, *Dams, *Backwater, *Condemnation value, Sites, Engineering structures, Grand Coulee Dam, Reservoirs, Condemnation, Eminent domain, Legal aspects, Judicial decisions, Federal government, United States, Riparian rights, Rivers, Navigable rivers, Navigation, Rivers and Harbors Act, Legislation, Riparian land, Property values, Compensation.

In proceedings by plaintiff United States to determine compensation for the taking of land bordering a navigable river, defendant riparian landowners contended that they were entitled to an additional compensation for their land which was to be flooded by the backwaters of a dam to be constructed by plaintiff. Defendants' claim for additional compensation was based upon their contention that the land area involved was the only suitable location for the dam. Consequently, they argued that the inherent adaptability of the uplands up a special use in the development of electrical power increased its value over the reasonable market value. The government contended that defendants' compensation was limited to the reasonable market value of the property taken. The court held that the government's absolute power to improve navigation by building the dam precluded private landowners from having any property right in the special use of the navigable waters or power inherent therein. Thus defendants were limited to the reasonable market value of the lands taken. (Snow-Florida)

MIAMI BEACH JOCKEY CLUB, INC V DERN (GOVERNMENT CONTROL OVER OBSTRUC-TIONS TO NAVIGATION). 86 F2d 135-136 (DC Cir 1936).

Descriptors: *Navigation, *Navigable waters, *Permits, *Administrative agencies, Relative rights, Judicial decisions, Legislation, Federal government, Landfills, Land forming, Eminent domain, Condemnation, Beds, Compensation, Administrative decisions, Regulation, Legal aspects, Supervisory control (Power), Beds under water. Identifiers: Obstruction to navigation.

Plaintiff jockey club, having been previously granted a permit by defendant Secretary of War authorizing the filling in of submerged lands in navigable waters, brought this action to enjoin defendant from revoking such permit. Plaintiff con-

tended that such revocation would amount to a takking of property without compensation and that the congressional act under which defendant was acting in revoking the permit, which conferred upon the Secretary of War the power to determine whether or not a proposed structure was an obstruction to navigation, was an unconstitutional delegation of legislative power. In a per curiam decision, the court rejected both contentions and held that the permit granted to improve the lands in question was revocable by defendant without compensation. Navigable waterways are always subject to the paramount authority of Congress in the constrol of navigation. (Snow-Florida)

ICKES V FOX (PROTECTION OF PRIVATE APJPROPRIATION RIGHTS IN A FEDERALI RECLAMATION PROJECT).

85 F2d 294-299 (DC Cir 1936).

Descriptors: *Federal reclamation law, *Appropriation, *Preferences (Water rights), *Water allocation (Policy), Federal government, United States, Legal aspects, Water law, Beneficial use, Irrigation water, Priorities, Judicial decisions, Adjudication procedure, Claims (Contract), Contract administration, Regulation, Water rights, Water contracts, Water requirements, Water distribution (Applied), Irrigation programs.

Plaintiff landowners brought action to restrain de-fendant Secretary of the Interior from diverting water into a reservoir for a federal reclamation project, thereby limiting plaintiff's water rights. Plaintiffs acquired their appropriation rights from the government's predecessor, an irrigation company, and contended that the amount of water supplied for beneficial use at that time, and for twenty years thereafter, was fixed by contract and could not be diminished. Defendant contended that the suit, being against the United States, could not be maintained and that defendant had the authority to limit plaintiffs' water rights since the water was necessary plainthis water rights since the water was necessary to maintain the reservoir. After holding that the suit was allowable as against an agent of the government rather than the government itself, the court found that the Federal Reclamation Act and state law both measured appropriation rights by the amount of water necessary to irrigate the land, and not by the mere diversion and storage of the water. Therefore, the court held that the property rights in the water were plaintiffs' rather than the federal government's and were appurtenant to plaintiffs' land. The court affirmed the order denying defendant's motion to dismiss. One justice dissented. (Liptak-Florida) W70-09479

KARLSON V UNITED STATES (CONDEMNA-TION OF FLOWAGE EASEMENT OVER RIPARIANS'S LANDS), 82 F2d 330-337 (8th Cir 1936),

Descriptors: *Eminent domain, *Water level fluctuations, *Easements, *Condemnation value, Condemnation, Legal asepcts, High water mark, Low water mark, Variability, Elevation, Lakes, Relative rights, Judicial decisions, Treaties, Federal Government, Dams, Flow control, Flooding, Property values, Compensation, United States, Beneficial

In a condemnation proceeding to obtain flowage easements upon lands bordering a lake, which was to be regulated in such a manner as to intermittently raise the water level above the natural high water mark so as to flood defendants' riparian lands, defendants contended that the land to be condemned would have no market value as a result of the intermittent flooding, and sought compensation in the amount of such lands' full present market value. The federal government contended that it was obtaining only an easement and not a free title to the land, and that the land could be put to beneficial use when not flooded. Consequently,

Nonstructural Alternatives—Group 6F

compensation at the present full market value was not required. The court held that where less than a fee interest is taken and where substantial enjoyment of the land remains in the owners, compensation is not required at a rate as if the whole property was taken. Inasmuch as it is a question for the jury to determine the value of the interest actually taken, the jury verdict granting defendants compensation at a rate less than the market value of the fee simple title was sustained. (Snow-Florida) W70-09481

BEHRENS V CITY OF MINNEAPOLIS (PUBLIC PROVEMENT). 271 NW 814-817 (Minn 1937).

Descriptors: *Minnesota, *Rivers, *Dredging, *Channel improvement, Riparian land, Riparian waters, Judicial decisions, Legislation, Legal aspects, River beds, Mississippi River, Navigable rivers, Headwaters, Taxes, Government finance, Public benefits, Highways, Barriers, Waterfalls, Navigation, Harbors.

Defendant city of Minneapolis proposed to dredge the Mississippi River a distance of 550 feet, including 410 feet fronting private riparian land equipped with docking facilities serving a gas company. Plaintiff taxpayer sought to enjoin the expenditure of city funds on the project on the grounds that the expenditure was not for a public purpose, as required by statute. Defendant contended: (1) that it was authorized to improve the channel under a It was authorized to improve the channel under a highway improvement statute; and (2) that improved docking facilities might lower the cost of gas in the area. Since St. Anthony Falls, a barrier to navigation, lay above the frontage to be dredged, the Supreme Court of Minnesota held that the only benefit derived from the dredging would accrue to the private gas company. The river was not a highway, and the court was not precluded by the highway statute from inquiring into the existence of highway statute from inquiring into the existence of a public behind proposed municipal expenditures. (Dye-Florida)
W70-09489

OLSEN V CITY OF DEARBORN (EVALUATION OF PROPERTY PARTIALLY PUBLIC UTILITY PURPOSES). TAKEN FOR

290 Mich 651, 288 NW 295-299 (1939).

Descriptors: *Michigan, *Condemnation value, *Compensation, *Public utilities, Land appraisal, Real property, Value, Property values, Condemnation, Judicial decisions, Damages, Legal aspects, Local governments, Public rights, Cities, Sewers, Pipelines, Adjudication procedure, Eminent domain, Pricing, Market value, Adjusted prices, Feonomic impact. Economic impact.
Identifiers: *Water mains.

Plaintiff landowners brought actions against defendant city to recover damages resulting from defendant city to recover damages resulting from detendant's construction of sewers and water mains across plaintiffs' property. Plaintiffs had tendered deeds to 18 foot strips of their land to the city to be used for streets and alleys, but defendant constructed the sewers and water mains before acquiring title to all of the property needed for the planned streets. Plaintiff contended that the condition attached to the delivery of the deeds acquisition attached to the deliverty of the deeds, acquisition of all the necessary property, was not per-formed. Therefore, plaintiffs contended that defendant had taken their property and was liable for the market value of the land taken. Defendant contended that the preparation of maps did not constitute a taking of property, and that the measure of damage for injury to the land caused by the sewers and water mains was the depreciation in the value of the land. Prevarience independ for aliquitification and water mains was the depreciation in the value of the land. Reversing a judgment for plaintiffs, the court held that, although defendant was without legal title to the property and had imposed an unlawful servitude upon the land, the proper measure of damages was the depreciation in the value of the property rather than the land's market value. (Liptak-Florida)

ERIE LACKAWANNA RY V SILLS (SUNKEN VESSEL OBSTRUCTING DOCKS TRESPASS).

307 NYS2d 803-804 (Sup Ct 1970).

Descriptors: *New York, *Navigation, *Harbors, *Remedies, Federal jurisdiction, Navigable waters, Ships, Transportation, Docks, Legislation, Admiralty, Legal aspects, Law of the sea, Judicial decisions, Federal government, Boats, Barriers, Relative rights, Hazards, Jurisdiction, Damages,

Identifiers: *Wreck Act.

Defendant was the owner of a barge which had sunk in a certain harbor. The barge obstructed access to plaintiff's docks. Plaintiff brought action under the federal Wreck Act charging defendant with an unlawful trespass by having abandoned the sunken barge. Defendant contended the Wreck Act did not apply to him since he had abandoned the barge in the navigable waters of the harbor. The court held that the rights and duties of the parties were governed by federal maritime law and that plaintiff's complaint was sufficient to sustain a cause of action based on the Wreck Act. The Wreck Act, although penal, would support civil actions by private parties against owners of vessels negligently or willfully sunk in navigable waters. It was only necessary that the plaintiff be within the class of persons Congress intended to protect and the harm the type Congress intended to protect and the harm the type Congress intended to forestall. Both damages and injunctive relief were available under the Act. (Hubener-Florida) W70-09500

6F. Nonstructural Alternatives

FLOOD PLAIN INFORMATION, COTTON-WOOD CREEK, GUTHRIE, OKLAHOMA. For primary bibliographic entry see Field 04A. W70-09220 Corps of Engineers, Tulsa, Okla.

PLAIN INFORMATION, SANTA VENTURA COUNTY, FLOOD RIVER, CALIFORNIA.

Corps of Engineers, Los Angeles, Calif. For primary bibliographic entry see Field 04A. W70-09221

INFORMATION, PLAIN METROPOLITAN ATLANTA GEORGIA, UTOY CREEK, NORTH AND SOUTH UTOY CREEKS. Corps of Engineers, Mobile, Ala. For primary bibliographic entry see Field 04A. W70-09222

FLOOD PLAIN INFORMATION, ALLEGHENY RIVER AND FIVEMILE CREEK, ALLEGANY, NEW YORK.

Corps of Engineers, Pittsburgh, Pa. For primary bibliographic entry see Field 04A.

FLOOD PLAIN MANAGEMENT - IOWA'S EX-PERIENCE.

lowa State Univ., Ames. Dept. of Civil Engineering.

Papers presented at Conference on Flood Plain Management, 6th Water Resources Design Con-ference, Jan 23-25, 1968, Iowa State University; Merwin D. Dougal, editor, published by Iowa State University Press, Ames, 1969, 270 p.

Descriptors: *Flood protection, *Non-structural alternatives, *Iowa, Flood plain zoning, Land use, Land management, Mapping, Data collections, Planning, Regulation, Flood plain insurance, Floodways, River basin development, Urbanization

Identifiers: Flood plain management.

Comprehensive planning of flood plains is a clear prerequisite to successful control and regulatory phases of flood plain management. This seven-part volume brings together in one integrated text the available information concerning the many phases of flood plain management. Part I presents the philosophy and need for flood plain management. Part II presents the physical flood problem and the future flood potential in Iowa. Part III is devoted to the development of action programs for flood plain management. Part IV deals with the planning role and its many facets. Part V presents the legal aspects of flood plain management. Part VI is devoted to technical flood plain information studies. Part VII contains two reports on the success of management programs in other states. (See also W70-09254 and W70-09255). (Knapp-USGS) W70-09253

FLOODS IN IOWA,

Geological Survey, Iowa City, Iowa. For primary bibliographic entry see Field 02E. W70-09254

FLOOD PLAIN MAPPING BY THE U. S. GEOLOGICAL SURVEY,

Geological Survey, Champaign, Ill. D. W. Ellis.

In: Flood Plain Management - Iowa's Experience, Papers presented at Conference on Flood Plain Management, 6th Water Resources Design Conference, Jan 23-25, 1968, Iowa State University; published by Iowa State University Press, Ames, p 197-206, 1969. 10 p, 15 ref.

Descriptors: *Floods, *Mapping, *Iowa, *United States, Maps, Flood protection, Warning systems, Data collections, Hydrologic data, Frequency analysis, Stage-discharge relations, Water levels, Profiles, Planning, Flood plain zoning, Flood control, Non-structural alternatives. Identifiers: USGS Hydrological Atlases.

Effective flood plain management requires a knowledge of the magnitude and frequency of floods to be expected and of the areas that will be inundated. The series of flood inundation reports (hydrologic atlases) of the USGS are intended to aid individuals and agencies responsible for making planning decisions by providing this needed hydrologic data. Components of the reports are the topographic map, a history of past floods, a flood frequency diagram, flood profiles, an oblique aerial photograph taken during the flood, and a brief explanatory text. The flood atlases present hydrologic data concerning the extent, depth, and frequency of flooding that are essential for an appraisal of hazards involved in development of flood plains. The atlases are useful in establishing programs of flood plain management, preparing building and zoning regulations, locating waste disposal facilities, purchasing open space, developing recreational areas, and managing surface water in relation to groundwater resources. (See also W70-09253). W70-09255 photograph taken during the flood, and a brief ex-

FLOOD DAMAGE PREVENTION. Tennessee Valley Authority, Knoxville. For primary bibliographic entry see Field 10. W70-09364

FLOOD PLAIN INFORMATION, COYOTE CREEK, SAN FRANCISCO BAY TO ANDERSON RESERVOIR, SANTA CLARA COUNTY, CALIFORNIA.

Corps of Engineers, San Francisco, Calif. For primary bibliographic entry see Field 04A. W70-09365

NATIONAL INSTITUTE OF ECOLOGY: AN INQUIRY, VOLUMES 1 AND 2. Ecological Society of America, Durham, N.C., and Peat, Marwick, Mitchell and Co.

Field 06—WATER RESOURCES PLANNING

Group 6F-Nonstructural Alternatives

Ecological Society of America Feasibility Study Report, March 25, 1970. 77 p, 2 fig, 17 tab. NSF Grant GB-6890-001.

Descriptors: *Ecology, *Institutions, Administrative agencies, Administration, Universities, Governments, Political aspects, Legal aspects, Research and development.

National Institute of Ecology Identifiers: (Proposed).

This study was made to determine whether the establishment of a National Institute of Ecology can enhance the level of ecological capability rela tive to that obtainable through the allocation of comparable resources to currently established organizations. It is proposed that the results of this study show that such an institute is both needed and feasible. In response to the expressed desires of many people in varied interest groups, the establishment of a National Institute of Ecology could provide a focus for the concentration of ecological activity. Its establishment could create the supportive and administrative vehicle for the continuation of the U. S. International Biological Program. It could provide manpower, facilities, and organization. It could provide direct and needed assistance to research and educational programs. It could serve as a national center for the storage and coordinated use of the data of ecology, help to standarize data collection and interpretation techniques, and, in general, make those data and techniques of maximum benefit to science and society. (Knapp-USGS) W70-09366

6G. Ecologic Impact of Water Development

ELECTRIC POWER - IMPACT ON THE EN-VIRONMENT, California Public Utilities Commission.

For primary bibliographic entry see Field 06B. W70-09020

MAJOR ELECTRIC POWER FACILITIES AND THE ENVIRONMENT, Edison Electric Inst., N.Y.

Robert N. Coe.

Amer Power Conf, Chicago, Ill, Apr 1970. 17 p.

Descriptors: Aesthetics, *Environment, Project planning, Safety, *Electric power, Electric power demand, Electric power production, Air pollution, Sites, *Reliability, Economics, Switchyards (Electrical), Transmission lines, Substations (Electrical), Transmission towers, Powerplant, Locations, Recreation facilities, Planning, *Public opinion. Identifiers: Living standards, Pollution control, Reautification Beautification.

Environmental problems of the utility industry, accompanied by regulatory and court delays that are inhibiting reliability standards in some areas, are considered and solutions presented. Electric power requirements of the nation have doubled every 10 The future indicates a continued growth as the standard of living improves. Planning and installing major electric power facilities needed to meet this growth require full consideration of environmental factors. Growth in facilities must be accomplished on a timely and orderly basis if an adequate and reon a timery and orderly obsist if an acceptate and re-liable electric power supply is to continue. Major electric power facilities include generating stations, transmission lines, large substations, and switching centers. Problems associated with building these facilities are: (1) engineering and physical, (2) environmental, and (3) economic. Electric utilities should make all reasonable efforts to enhance the scenic and aesthetic values of project areas. Personnel responsible for location, design, construction, and operation of facilities should be sensitive to their environmental responsibilities and to their responsibility for providing adequate, economic, and reliable electric service. (USBR) W70-09048

ENVIRONMENTAL CHANGES PRODUCED BY COLD-WATER OUTLETS FROM THREE AR-KANSAS RESERVOIRS,

Arkansas Univ., Fayetteville. Water Resources Research Center.

Research Center.
Carl E. Hoffman, and Raj V. Kilambi.
Available from NTIS as PB-193 675, \$3.00 in paper copy, \$0.65 in microfiche. Arkansas Univ.
Water Resources Research Center, Publication No. 5, 1970. 169 p, 10 tab, 15 fig, 65 ref, 10 append. OWRR Project A-001-ARK (8).

Descriptors: *Tailwater, *Temperature, *Current (Water), *Trout, Phytoplankton, Zooplankton, Benthic fauna, Chironomidae, Oligochaetes, Isopods, Amphipoda, Mayflies, Chrysophyta, Cyanophyta, Chlopophyta, *Fish, Cold-water fish, Arkansas, Benthos, Invertebrates. Identifiers: Trichoptera, Buffalo River (Arkansas),

Kings River (Arkansas), Chironomidae.

Water qualities of two natural streams (Buffalo and Kings Rivers), one new coldtailwater (Beaver), and two old coldtailwaters (Norfork and Bull Shoals) in northwestern Arkansas were studied from July 1965 through October 1968. The essential difference between the old coldtailwaters and natural streams is a change in water quality which allows the development of a new productive ecological environment. Features which typify the old tail-waters are as follows: (1) relatively homoiothermal temperatures; (2) stream beds scoured by strong hydroelectric power generation currents; (3) abundant phytoplankton and benthic macroinver-tebrates; and (4) absence of warm water game fishes. Environmental factors characterizing natural streams are as follows: (1) high summer temperatures; (2) seasonal and individual current fluctuations at the various stations; (3) a greater variety of benthic macroinvertebrates and ichthyofauna; (4) abundant zooplankters; and (5) a tendency toward an equal distribution of the phyla Chrysophyta, Cyanophyta, and Chlorophyta. By October 1968, the new Beaver coldtailwater had lost all of its warm-water characteristics but had not developed the biotic features of the old tailwaters W70-09344

ENVIRONMENTAL QUALITY.

Council on Environmental Quality, Washington, D.C.

For primary bibliographic entry see Field 05G. W70-09347

PROCEEDINGS WORKSHIP ON MOSQUITO CONTROL IN NORTH CAROLINA,, North Carolina Water Resources Research Inst.,

Available from NTIS as PB-193 719, \$3.00 in paper copy, \$0.65 in microfiche. Report No 36, Water Resources Research Institute, University of North Carolina, 1970. 144 p. OWRR Project A-999-NC (17).

Descriptors: *Mosquitoes, Aquatic insects, Public health, Aquatic habitats, Entomology, *Insect control, Insecticides, Larvicides, *Pesticides, *Water management, Drainage, Insect physical control, North Carolina.

Identifiers: Mosquito control drainage, Mosquito control impoundment.

The objectives of this workshop held on May 4, 1970 at Rangemont, North Carolina, were to explore present mosquito control practice, transition away from persistent pesticides, minimization of ecological impact, integration of mosquito control with water resource management, program coordination, and develop recommendations concerning changes in the program together with research and educational needs. Participants included representatives of federal and state agencies and electric utilities concerned with mosquito control and its implications to water resource management. This is the fourth in a series of research workshops sponsored by the Institute to increase communication between research users and researchers on water resource problems and research needs (Howells-Univ. of North Carolina) W70-09421

SCENIC RIVERS IN MARYLAND.

Maryland Dept. of State Planning, Baltimore.

Available from NTIS as PB-191 288, \$3.00 iri paper copy, \$0.65 in microfiche. State Planning Dept. Pub 161, Mar 70. 42 p.

Descriptors: *Wild rivers, Conservation. Identifiers: Scenic Rivers.

The report represents the first in a series of annuals findings and recommendations to the General As-sembly from the Maryland Scenic Rivers Reviews Board concerning the designation of Scenic Rivers in Maryland. Five rivers are recommended for official Scenic River designation. When approved, these rivers would represent the beginning of a Scenic Rivers System for Maryland.

07. RESOURCES DATA

7A. Network Design

PROPOSED STREAMFLOW DATA PRO-GRAM FOR MAINE,

Geological Survey, Augusta, Maine. G. S. Hayes, and R. A. Morrill.

U S Geological Survey Open-file report, 1970. 38 p, 2 fig, 4 tab, 6 ref, append.

Descriptors: *Data collections, *Hydrologic data, *Streamflow, *Network design, *Maine, Statistical methods, Streamflow forecasting, Regression analysis, Stream gages, Gaging stations, Planning, Discharge measurement. Identifiers: Streamflow data.

An evaluation of the streamflow data available in Maine was made to provide guidelines for planning future programs. The basic steps in the evaluation procedure were (1) definition of the longterm goals of the streamflow data program in quantitative form, (2) examination and analysis of all available data to determine which goals have already been met, and (3) consideration of alternate programs and techniques to meet the remaining objectives. It was found that many of the goals could be met by generalization of the data for gaged basins by regression analysis. This indicates that changes could be made in the present data program that would allow emphasis to be placed on attaining the goals that have not been met. A streamflow data program based on the guidelines developed in this study is proposed. (Knapp-USGS)

7B. Data Acquisition

AN ELECTRO-OPTICAL PROBE FOR MEASUREMENT OF SUSPENDED SEDIMENT CON-CENTRATION,

Iowa Univ., Iowa City. For primary bibliographic entry see Field 02J. W70-09026

RUNOFF SYNTHESIS FOR RAIN-ON-SNOW BASIN.

Corps of Engineers, Portland, Oreg. North Pacific For primary bibliographic entry see Field 02E. W70-09027

USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING, Norges Tekniske Hoegskole, Trondheim.

Eng Geol, Vol 4, No 1, p 73-88, Jan 1970. 16 p, 24 fig, 1 tab, 15 ref.

Descriptors: *Tracers, *Radioisotopes, *Coastal engineering, *Harbors, *Oceans, *Oceanography, Rivers, Bibliographies, Methodology, Foreign research, Underwater construction, Reviews, Sedimentation, *Sediment transport.

Identifiers: *Radioactive tracers, *Fluorescent tracers, Norway, Steady-dilution method, Space-integration method.

Radioactive and fluorescent tracers have been used for over 10 yr, and usage is being expanded by improvement in existing fields and new applications. Use now covers a wide range of fields including harbor, ocean, coastal and river engineering, littoral drift, dredging technology, and pollution control. A history of the development of methodology for using radioactive and fluorescent tracers is outlined and examples of application are given. Radioactive and fluorescent tracers are compared. Pertinent aspects of tracer technology and methods of analyses for determining drift pattern and quantity are discussed. Underwater TV may be useful, particularly if the problem of underwater exitation of fluorescent tracers is solved. A list of literature on tracer projects in various fields of science and technology is included. Has 15 references. (USBR) W70-09029

PROFILING SUBBOTTOM ACOUSTIC SYSTEMS, A STATE-OF-THE-ART SURVEY, Army Engineer Waterways Experiment Station,

Vicksburg, Miss. For primary bibliographic entry see Field 02A.

w70-09176

P-N JUNCTIONS--A TOOL FOR TEMPERA-

TURE MEASUREMENT, Battelle Memorial Inst., Richland, Wash. Earth Sciences Section.

Carl G. Enfield, and John M. Tromble. Water Resources Research, Vol 6, No 3, p 981-985, June 1970. 5 p, 5 fig, 1 tab.

Descriptors: *Thermometers, *Instrumentation, Calibrations, Temperature, Electronic equipment. Identifiers: P-N junction thermometers.

Silicon semiconductors were investigated for use as temperature transducers between 25 and 75 deg C and were found to have good stability, linearity, and high sensitivity. When one ma of forward current was applied to a diode, a sensitivity of approximately 1.9 mv/deg C was obtained with a forward voltage drop of approximately 600 mv. (Knapp-USGS) W70-09212

DISPERSION PREDICTION FROM CURRENT

METERS, Ontario Water Resources Commission, Toronto. Water Quality Surveys Branch.
For primary bibliographic entry see Field 02E.
W70-09219

MEASUREMENT OF THE THERMAL CON-DUCTIVITY OF FROST BY A TRANSIENT HOT-WIRE TECHNIQUE, North Carolina State Univ., Raleigh. Dept. of

Mechanical and Aerospace Engineering. For primary bibliographic entry see Field 02C. W70-09233

COMPARATIVE STUDY OF THE WATER BALANCE IN THE AERATED ZONES WITH RADIO-ACTIVITE METHODS AND WEIGHA-BLE LYSIMETER,

Landbouwwetenschappen, Rijksfaculteit der Ghent (Belgium).

For primary bibliographic entry see Field 02G. W70-09263

MEASURING SOIL MOISTURE IN THE BRENIG CATCHMENT: PROBLEMS OF USING NEUTRON SCATTER EQUIPMENT IN SOIL WITH PEATY LAYERS,
The Water Research Association, Medmenham

For primary bibliographic entry see Field 02G. W70-09264

AN INSTRUMENT FOR MEASURING SOIL MOISTURE BY NEUTRON SCATTERING, Swedish Meteorological and Hydrological Inst.,

Stockholm (Sweden).

Todor Milanov.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 88-95, 1968. 8 p, 6 fig, 7 ref.

Descriptors: *Soil moisture meters, *Nuclear moisture meters, *Calibrations, Moisture meters, Soil moisture, Instrumentation, Moisture content, Nuclear meters.

Identifiers: *Neutron-scatter moisture meters.

At the Swedish Meteorological and Hydrological Institute the neutron method has for some years been used for studies on soil moisture by means of a Danish apparatus. This report deals with the measuring equipment, sources of error, calibration technique, etc. The moisture probe is equipped with a 5 mC Ac-Be neutron source, combined with a scintillation crystal of Lithium Iodide as detector. The maximum error for 160 measurements made by the moisture probe in its standard was found to be about 1%, corresponding to a relative error of 0.5%. The calibration was made in moisture models, made of fine sand mixed with a substance containing crystal water. Some soil moisture measurements made in the field in a homogeneous soil are reported. (See also W70-09266). (Knapp-USGS)

W70-09265

CHANGES IN THE MOISTURE CONTENT OF THE TOPSOIL AS MEASURED WITH A NEUTRON MOISTURE GAUGE,

Institute of Technology, Stockholm (Sweden). For primary bibliographic entry see Field 02G.

THE DETERMINATION OF SOIL MOISTURE WITH THE NEUTRON SCATTERING METHOD IN FINLAND,

Finnish Hydrological Office, Helsinki.

J. Virta.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 105-108, 1968. 4 p, 3 tab, 2 ref.

Descriptors: *Nuclear moisture meters, *Soil moisture meters, *Calibrations, Mositure meters, Soil moisture, Instrumentation, Mositure content, Nuclear meters, Evapotranspiration.

Identifiers: Neutron-scatter moisture meters, Fin-

The neutron method for measurements of soil moisture has been used in Finland from the year 1964. The Hydrological Office has had two measuring sites in forest, with six or seven measuring tubes. In each tube the moisture has been determined at different depths. The measurements have been carried out once a month during the winter been carried out once a month during the winter and twice monthly during the summer. The pur-pose is to determine the fluctuations of soil moisture and to examine the possibility of comput-ing the evapotranspiration from these measure-ments. The results of the measurements are presented and the effects of the instability of the measuring system and the irregular areal distribution of the change of soil moisture content are discussed. (See also W70-09268). (Knapp-USGS) W70-09267

NEUTRON MOISTURE METER FOR SALINE SOILS.

All-Union Scientific and Research Institute of Hydrotechnics and Reclamation (USSR).

L. I. Beskin, V. A. Emelyanov, and B. M.

Kondratyev

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 109-112, 1968. 4 p, 3 fig.

Descriptors: *Nuclear moisture meters, *Soil moisture meters, *Calibrations, Moisture meters, Soil moisture, Instrumentation, Moisture content, Nuclear meters, Gamma rays.

Identifiers: *Epithermal neutron moisture meters.

The principle of action of well-known neutron moisture meters is based on detecting thermal neutrons, which appear when rapid neutrons are being slowed down by hydrogen nuclei. However, the moisture meters with such detectors are sensible to changes in the percentage of chloride, boron, lithium and other excessively strong absorbers of neutrons, which may result in considerable errors in measuring the moisture of soils containing these elements. It is possible to reduce the action of the excessively strong absorbers by means of detection of epithermal neutrons, but this will deteriorate sensitivity of the moisture meters. Best suited for the job is the method of measuring the moisture of soils by total density of thermal neutrons and the gamma photons in a cadmium screen. The method is, under certain conditions, practically insensitive to any changes in percentage of chloride and con-siderably less sensitive to any changes in percentage of other excessively strong absorbers. When moisture is being measured by the moisture meter with such a detector, a single calibration may be used on all types of soils of nonorganic origin, provided the admissible absolute error is plus or minus 2%. (See also W70-09269). (Knapp-USGS) W70-09268

MEASUREMENT OF SOIL MOISTURE FROM THE TEMPERATURE GRADIENT,

Forest Research Inst., Budapest (Hungary).

T. Foldi, and L. Szonyi. French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 113-119, 1968. 7 p, 6 fig, append.

Descriptors: *Soil moisture meters, *Thermal conductivity, Instrumentation, Calibrations, Moisture meters, Soil temperature, Thermal properties, Soil

Identifiers: Temperature gradient moisture meters.

A new method for measuring soil moisture is described. Near a heat transmitter with stabilized heat flux, thermal conductivity of the soil can be determined and recorded from the temperature gradient. Using a corrosion resistant transmitter introduced into the soil and ensuring constant calibration conditions, soil moisture can be measured and recorded. For determining soil moisture a new electric method was developed, which is in-dependent from the concentration of the soil solution, thus being suitable for measuring and recording moisture in soils of different structure. The measuring probe is weather proof, resistant to mechanical effects during installation into the soil, and to influences of temperature for extended periods. (See also W70-09269). (Knapp-USGS) W70-09269

SOME METHODS FOR THE DETERMINATION OF SOIL MOISTURE AND BALANCE MEA-SURING,

Inst., Prague (C-Research Hydraulic zechoslovakia). Jiri Vasa.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International

Field 07—RESOURCES DATA

Group 7B—Data Acquisition

Association of Scientific Hydrology, Publication No 82, p 119-124, 1968. 6 p, 3 fig, 1 tab, 10 ref.

Descriptors: *Soil moisture, *Measurement, *Sampling, *Electrical resistance, Soil moisture meters, Laboratory tests, On-site tests, Water balance, Hydrologic budget, Energy budget, Rain gages, Calibrations.
Identifiers: Soil moisture determination.

Methods of measuring soil moisture and water balance used in Czechoslovakia are reviewed. Sampling, electrical resistivity methods, water budget, and energy budget methods are briefly discussed. A rain gage calibration table is included to aid in estimating the proportion of gaged rain actually reaching the ground. Soil sampling equipment is described. (See aslo W70-09271). (Knapp-USGS) W70-09270

POLISH ISOTOPE **APPARATUS** FOR RESEARCH ON SOIL MOISTURE, Hanna Filipkowska.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 124-131, 1968. 8 p, 3 fig, 9 ref.

Descriptors: *Nuclear moisture meters, *Soil moisture meters, *Calibrations, Moisture meters, Soil moisture, Instrumentation, Moisture content, Nuclear meters

Identifiers: *Poland, Soil moisture measurement, Neutron-scatter moisture meters.

Polish probes manufactured by the Bureau for the Nuclear Technique Installation which serve to measure soil moisture were described. They allow determination of the water content in the surface layer and at depth. The basic part of each probe is source of fast neutrons and the GEIGER-MULLER counter covered with cadmium. As a source of fast neutrons the mixture Pu + Be or Po + Be has been used. To use the probes in practice one should define for each of them the dependence between the impulse intensity recorded on the scaler and the soil moisture. When the probe calibration is performed one should take into ac-count the influence of bulk density of the ground on moisture and the eventual errors due to contents of elements which strongly absorb neutrons in the ground mixture.s. Soil moisture measurements may be performed within the range of 0-45% of volume moisture, with accuracy of 0.3-1.5, according to the manufacture data. The results obtained always refer to a sphere with a radius of 15-25 cm. (See also W70-09272) (Knapp-USGS) W70-09271

NUCLEAR TECHNIQUES IN HYDROLOGICAL INVESTIGATIONS IN THE UNSATURATED

International Atomic Energy Agency, Vienna (Austria). Div. of Research and Laboratories.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 131-145, 1968. 15 p, 5 ref, 2 append.

*Nuclear moisture *Radioisotopes, *Moisture meters, *Soil moisture meters, Calibrations, Soil moisture, Soil water, Instrumentation, Moisture content, Nuclear meters, Surveys, Reviews.

Identifiers: Neutron-scatter moisture meters.

Nuclear and isotopic techniques which may aid in investigations of the unsaturated zone are discussed. The discussion includes methods for the determination of soil water content and methods for investigation of the movement of soil moisture. The recommendations of the joint FAO/IAEA conference on the Use of Isotopes and Radiation

Techniques in Soil Moisture and Irrigation Studies held at Vienna in March 1966 are annexed. A list of definitions of terms relating to neutron soil moisture gages is also given. (See also W70-09273) (Knapp-USGS) W70-09272

CALIBRATION AND EVALUATION OF A WIDE RANGE METHOD FOR MEASURING MOISTURE STRESS IN FIELD SOIL SAMPLES, Geological Survey, Denver, Colo. Water Resources

I. S. McQueen, and R. F. Miller.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 147-155, 1968. 9 p, 2 fig, 2 tab, 16 ref.

Descriptors: *Moisture stress, *Soil moisture meters, Soil moisture, Calibrations, Instrumentation, Laboratory tests, On-site tests, Membrane processes, Osmosis, Membranes. Identifiers: Moisture stress meter.

A moisture stress measurement for each gravimetric soil moisture sample, made possible by development of a wide-range method using filter paper as stress sensors, is supplying answers to some difficult hydrologic problems. The moisture stress existing in a gravimetric sample can be measured within 2 percent and the range covered is from 0 to 1500 bars. Calibration of the method was accomplished in the laboratory and in the field using saturated salt solutions (15 to 1500 bars), a pressure membrane extractor (1 to 15 bars), a pressure plate assembly (0.1 to 1 bars), and equilibrium above a water table (0 to 0.2 bars). Disturbance of the sample has little effect on results at stress levels above 0.2 bars. At stress levels below 0.2 bars, special handling and sampling techniques should be used to obtain samples with minimum disturbance. (See also W70-09274) (Knapp-USGS) W70-09273

HYDRAULIC AND PRESSURE HEAD MEA-SUREMENT WITH STRAIN GAUGE PRESSURE

TRANSDUCERS, Illinois Univ., Urbana; and Agricultural Research Service, Urbana.

A. Klute, and D. B. Peters.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 156-165, 1968, 10 p, 6 fig, 8 ref, append.

Descriptors: *Soil water movement, *Soil moisture meters, Tensiometers, Instrumentation, Calibrations, Moisture meters, Soil moisture, Soil water, Moisture tension.

Identifiers: Strain-gage tensiometers.

Sensitive, responsive tensiometers are highly useful in laboratory and field studies of water movement in unsaturated soil. Strain gage pressure transducers of the diaphragm type have been incorporated into a tensiometer system that has a short response time, is capable of detecting tension changes as small as a few millimeters of water and has the adsmall as a tew minimeters of water and has the advantage of an electrical output that can be recorded. Construction details, precautions to be observed in use and operational procedures are given for direct reading and null modes of measurement. A manifold for the use of a single transducer with a number of tensiometer cups and the possible use of the tensiometer in field measurements are described. (See also W70-09275) (Knapp-USGS) W70-09274

DIRECT MEASUREMENT OF MOISTURE POTENTIAL: A NEW TECHNIQUE, Commonwealth Scientific and Industrial Research

Organization, Canberra (Australia). Div. of Plant Industry. A. J. Peck, and R. M. Rabbidge.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium,
The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publications No 82, p 165-170, 1968. 6 p, 1 fig, 4 ref.

Descriptors: *Soil moisture meters, *Tensiometers, s, Instrumentation, Calibrations, Moisture meters, Soil moisture, Soil water, Moisture tension, Membrane processes, Osmosis, Membranes. Identifiers: Osmotic tensiometer.

Although conventional tensiometers are simple and i capable of yielding fairly precise data, their usefulness is frequently limited by their range. Gypsum or nylon blocks, which cover a much greater range of moisture potentials, exhibit hysteresis and consequently may be in considerable error. A new technique for direct measurement of moisture potential over the full range of agricultural and hydrological importance has been developed. The basis of this technique is that an osmotic solution is used to depress the zero of moisture potential in the measuring instrument by a known amount. Water is exchanged between the soil and the instrument via a semi-permeable membrane until an equilibrium of free energy of water is reached. The change of free energy within the instrument can be designed to be almost entirely a result of a change of pressure which actuates a pressure transducer. The instrument can be adapted to measure either matric or total potential. Tests of early models of the instrument indicate response time constants of only a few minutes. (See also W70-09276) (Knapp-USGS) W70-09275

CAPILLARY CONDUCTIVITY DATA ESTI-MATED BY A SIMPLE METHOD,

Institute for Land and Water Management Research, Wageningen (Netherlands). G. P. Wind.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 181-191, 1968. 11 p, 6 fig, 4 tab, 3 ref.

Descriptors: *Capillary conductivity, *Estimating, *Laboratory tests, Bouyoucos blocks, Permeameters, Soil water movement, Percolation, Unsaturated flow, Evaporation, Drying, Flow, Porous media, Moisture stress.

Identifiers: Capillary conductivity estimation.

A simple method is given for estimating capillary conductivity by study of soil samples in the laboratory. A vertical column of soil is allowed to evaporate at the top; all other sides are completely closed. Every day the total weight of the column is read and determinations are made of the moisture content and moisture tension at a number of depths. The velocity of flow for different depths can be calculated from the changes in moisture content and weight. The potential gradient can be read from the moisture tension readings, making it possible to calculate the capillary conductivity. A difficulty is that a pF-curve is needed when moisture content or moisture tension is determined. In the latter case, used in this paper, the total amount of moisture in the column determined from tension data and the pF-curve does not agree with the amount determined from the total weight. This means the flow velocity cannot be calculated exactly. The reason is that the pF-curves used lack sufficient reproducibility. They can be fitted to the soil column used by the iteration technique described. The capillary conductivity values, determined with the aid of Bouyoucos' electrical nylon units, are fairly accurate at moisture tensions between 0.1 to 20 atmospheres. Below 0.1 atmosphere they lack accuracy. An advantage of this method is, that it is a true imitation of some moisture flow processes which occur in nature and to which knowledge of the capillary conductivity has to be applied. (See also W70-09278) (Knapp-USGS)
W70-09277

Data Acquisition—Group 7B

IFFUSIVITY DETERMINATION BY A NEW OUTFLOW METHOD,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant

ndustry. A. J. Peck.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 191-202, 1968. 12 p, 7 fig, 12 ref.

Descriptors: *Soil moisture movement, *Diffusivi-y, Flow, Porous media, Laboratory tests, Per-meameters, Mathematical studies, Membrane processes, Osmosis, Membranes, Moisture tension, Unsaturated flow.

dentifiers: Soil diffusivity.

A method of deducing soil moisture diffusivities from laboratory outflow data is described. This method involves the matching of outflow data to a single theoretical curve regardless of the membrane conductance. The new method involves an assumption of constant diffusivity over the range of moisture contents involved in a 'step'. In order that the experiments should approximately satisfy this assumption, it is usual to use only small 'steps'.

Data obtained from some of the outflow experiments reported, wherein the diffusivity varied by up to an order of magnitude, matched the theoretical curve as well as small step data. Diffusivities deduced from these large step experiments agreed well with the integrated means of small step diffusivities. It appears that, with the new analysis the use of large steps is reasonable provided that the membrane conductance is greater than the hydraulie conductivity of the test piece. An analysis of errors arising with the new method suggests that possible errors in diffusivity of as little as 30% possible errors in diffusivity of as little as 30% should be readily obtainable and experimental data support this. This is a significant improvement on previous data which indicate errors of up to an order of magnitude. It is suggested that sample variability may be the basis for such large errors. (See also W70-09279) (Knapp-USGS) W70-09278

SOIL WATER DIFFUSIVITY AND WATER CONTENT DISTRIBUTION DURING OUT-

FLOW EXPERIMENT, California Univ., Davis. Dept. of Water Science and Engineering; Oklahoma State Univ., Stillwater; Arizona Univ., Tucson; and North Dakota State

For primary bibliographic entry see Field 02G. W70-09280

AN INFILTRATION METHOD FOR THE DETERMINATION OF THE CAPILLARY CONDUCTIVITY OF UNDISTURBED SOIL CORES, Institute for Land and Water Management Research, Wageningen (Netherlands).

J. Wesseling, and K. E. Wit.

French resume, In. Water in the Unsaturated Zone.

French resume. In: Water in the Unsaturated Zone, French resume. In: Water in the Onsatutated Zolie, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19025, 1966, International Association of Scientific Hydrology, Publication No 82, p 223-234, 1968. 12 p, 11 fig, 1 tab, 18 ref.

Descriptors: *Capillary conductivity, *Soil water movement, *Laboratory tests, Permeameters, Infiltrometers, Saturated flow, Unsaturated flow, Soil texture, Tensiometers, Sampling, Cores. Identifiers: Capillary conductivity measurement, Soil core samples.

Soil core samples.

A method for the determination of the capillary conductivity was developed based on the infiltra-tion of water into vertical columns. By using accution of water into vertical columns. By using accurate drip feeding systems and small tensiometers with a soil filling, instead of a porous cup it is possible to measure suction gradients and to compute K-values simply. The method developed was applied to both disturbed soil samples and to undisturbed cores. For the sandy material a relatively wide range of suctions was found in which the capillary conductivity remains equal to the value of satura-

tion. A good agreement was found between the point where the moisture content drops rapidly in the pF-curve with increasing suction and the point where the capillary conductivity drops with increasing suctions. For the finer textured soils the range of constant K-value is practically absent. The results of the disturbed sandy samples do not fit in the general equation proposed by Rijtema (1965). For the undisturbed samples, however, a fairly good agreement was found. (See also W70-09282) (Knapp-USGS) W70-09281

DIVERGENCES BETWEEN EXPERIMENTAL AND THEORETICAL VALUES OF CAPILLARY DIFFUSIVITY (FRENCH),

State Coll. of Agronomical Sciences, Gembloux (Belgium).

For primary bibliographic entry see Field 02G. w 70-09285

DETERMINATION OF PORE SIZE BY THE AIR

BUBBLING PRESSURE METHOD, Institute for Land and Water Management Research, Wageningen (Netherlands). W. P. Stakman.

French resume. In: Water in the Unsaturated Zone, Vol I, Proceedings of the Wageningen Symposium, The Netherlands, June 19-25, 1966, International Association of Scientific Hydrology, Publication No 82, p 366-372, 1968. 7 p, 2 fig, 16 ref.

Descriptors: *Porosity, *Porous media, *Laboratory tests, *Instrumentation, *Bubbles, Permeability, Soil water movement, Groundwater movement, Unsaturated flow, Surface tension, Wetting, Capillary action, Pore pressure, Hydraulic gradient, Pressure, Permeameters, Tensiometers. Identifiers: *Pore size, Pore size determination,

Air-bubble permeameters.

The air bubbling pressure method is often used to determine the largest pore size of ceramic material whose geometrical pattern is unchangeable. A regularly increasing pressure is applied to the water-saturated porous material. The pressure at which air bubbles start to escape from the material is read from a manometer and is called the air bubbling pressure. From this the equivalent diameter of the largest passageway can be calculated. This method is not only useful to check the maximum pore size of porous plates or membranes in soil physical research but makes it possible to relate pore size of sandy soils to the hydraulic conductivity and other properties. The air bubbling pressure may serve as the starting-pressure for the determay serve as the starting-pressure for the determination of the capillary conductivity. For sand separates the maximum air bubbling pressure was reached with sample-heights of 8 to 14 mm. (See also W70-09298). (Knapp-USGS) W70-09297

ESTIMATING STORAGE CAPACITY IN DEEP ALLUVIUM BY GRAVITY-SEISMIC GRAVITY-SEISMIC METHODS.

Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center. For primary bibliographic entry see Field 02F. w70-09373

EXPERIENCES WITH SNOW PILLOWS IN

NORWAY, Norwegian Water Resources and Electricity Board, Oslo.

For primary bibliographic entry see Field 02C. W70-09375

A GAMMA-PHOTONEUTRON METHOD FOR LABORATORY STUDIES OF SOIL WATER, Du Pont de Nemours (E. I.) and Co., Aiken, S.C. For primary bibliographic entry see Field 02G.

MEASUREMENT OF WATER POTENTIAL AND OSMOTIC POTENTIALS IN SOIL WITH A COMBINED THERMOCOUPLE PSYCHROME-TER AND SALINITY SENSOR,
Agricultural Research Service, Riverside, Calif.

Salinity Lab.

For primary bibliographic entry see Field 02G. W70-09384

DETERMINATION OF THE VELOCITY AND DIRECTION OF GROUNDWATER FLOW BY RADIOISOTOPES,

Middle Eastern Regional Radioisotope Center for the Arab Countries, Cairo (Egypt). For primary bibliographic entry see Field 02F. W70-09386

GROUNDWATER AND MINING GEOPHYSICS/1967.

Geological Survey of Canada, Ottawa (Ontario).

Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, L. W. Morley, editor. Canada Geological Survey Economic Geology Report No 26, 1970. 722 p.

Descriptors: *Conferences, *Geophysics, *Exploration, *Groundwater, Surveys, Mapping, Water resources development, Electrical studies, Seismic studies, Magnetic studies, Borehole geophysics, Data collections, Hydrologic data, Hydrogeology, Geothermal studies, Gravity studentifiers; Geophysics symposium. Identifiers: Geophysics symposium

This volume is a record of the proceedings of the Canadian Centennial Conference on Mining and Groundwater Geophysics, held at Niagara Falls, Canada in October, 1967. One of the objects of the conference was to produce an up-to-date reference text on Mining and Groundwater Geophysics. The general subjects discussed include the state of the art, mapping, metals exploration, groundwater exploration, and national facilities for geophysical work. (See also W70-09393 thru W70-09409). (Knapp-USGS)

GEOPHYSICS IN PROSPECTING AND EXPLORATION FOR MINERAL DEPOSITS IN

THE U.S.S.R.,
Ministerstvo Geologii, Moscow (USSR).
V. V. Fedynsky, V. V. Brodovoi, and V. A. Gelamkov.

French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Report No 26, p 667-687, 1970. 21 p, 17 fig, 1 tab, 29 ref.

Descriptors: *Geophysics, *Exploration, *Surveys, Reviews, Foreign research, Economics, Projects, Research and development, Groundwater, Borehole geophysics, Water resources development Identifiers: *USSR.

Geophysical methods are widely used in the Soviet Union in the exploration and prospecting of deposits of metallic and nonmetallic minerals and rare earths as well as groundwater. The organiza-tion of geophysical exploration is based on the principle of the interrelation of geological and geophysical data. Results of geophysical surveys are widely used for the compilation of metallogenetic, tectonic and geological maps. Geophysical cal methods are used not only in the direct search for orebodies but also in the indirect search, structural-tectonic and lithological features indicating favorable areas for further study. Borehole methods, three-component magnetometry and geochemistry. (See also W70-09392). (Knapp-USGS) geophysics is receiving increasing attention, espe-W70-09393

Field 07—RESOURCES DATA

Group 7B—Data Acquisition

ELECTROMAGNETIC AERIAL SURVEY OF A FRESH WATER-SALT WATER CONTACT IN THE RHONE DELTA (FRENCH),

Bureau of Geologic and Mine Research (France); and Geoterrex Co. (France). P. Baudoin, G. Durozoy, and M. Utard.

In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology Report No 26, p 626-637, 1970. 12 p, 12 fig, 1 tab, 7 ref.

Descriptors: *Magnetic studies, *Saline water-freshwater interfaces, *Aquifers, *Groundwater, Geophysics, Remote sensing, Surveys, Aircraft. Identifiers: Airborne electromagnetic surveys.

The results of an airborne survey on a contact between salty and fresh groundwater previously studied by ground methods are presented. The geology consists of three to four layers, the first and third layer being conductive. The correlation between contour maps of the amplitude of EM anomalies and ground resistivity maps is good and evidence is given of detecting the main fresh-water zones. It is possible, in some cases, from the comparison of the various EM amplitude contour maps corresponding to measurements at various times after the end of the energizing pulse, to approximately determine whether apparent conductivity changes are caused by changes in shallow layers or at depth. More generally, EM maps established from a multitime or multifrequency EM system appear to be as interesting as some conventional resistivity maps obtained with various electrode spacings. The interpretation however is purely qualitative and has to be controlled by ground geophysics. (See also W70-09392) (Knapp-USGS) W70-09394

PROSPECTING GEOPHYSICAL AND RESEARCH ON UNDERGROUND WATER

(FRENCH), J. J. Breusse.

In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology Report No 26, p 638-640, 1970. 3 p.

Descriptors: *Exploration, *Geophysics, *Ground-water, Surveys, Borehole geophysics, Electrical studies, Resistivity, Seismic studies, Hydrogeology, Water table, Aquifers.
Identifiers: Groundwater prospecting.

The principal methods which are applied to groundwater investigations and the types of hydrogeological problems to which geophysical techniques can be applied are discussed. The principal electrical methods are: resistivity, profiling, resistivity mapping and electrical sounding. Seismic refraction is generally used to complement electrical methods. The main hydrogeological problems dealt with by geophysics are alluvial formations, perched water-tables, the search for basins, sand-dune aquifers and the reconnaissance studies of aquifers penetrated by saline waters. For structural aquiters penetrated by saline waters. For structural studies, geophysics can be used for delineating horsts, grabens, water sills, granitic sands and fracture zones. Electrical logging methods have wide application. Still the most widely used geophysical methods in hydrogeology are the lightweight and economical electrical methods. (See also W70-09392) (Knapp-USGS)

GEOPHYSICAL STUDIES IN PERMAFROST REGIONS IN THE U.S.S.R., Moscow State Univ. (USSR). Dept. of Geophysics.

A. A. Ogilvy.

French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology Report No 26, p 641-648, 1970. 8 p, 9 fig, 1 tab, 1 ref.

Descriptors: *Geophysics, *Permafrost, Electrical studies, Seismic studies, Exploration, Resistivity, Velocity, Frozen soil, Frozen ground, Geothermal studies

Identifiers: USSR, Permafrost geophysics.

Nearly half the territory of the Soviet Union is covered by permafrost. It is widely studied by geophysics, especially be geoelectric methods. The resistivity of frozen soils depends on the ratio of ice and water contained in the pores. Sand resistivity increases sharply when temperature drops below 0.5 deg C. Clay acquires high resistivity with a drop in temperature to from -2 to -6 deg C. The velocity of propagation of elastic waves considerably increases in frozen soils. By electrical soundings the upper and lower surfaces of permafrost can be determined. Measurement of rock resistivity conducted in fixed-time intervals make it possible to determine shifts in the permafrost boundary. Observations on the advance and retreat of permafrost are important for populated areas, mines, hydrotechnical and other engineering projects. (See also W70-09392) (Knapp-USGS)

GEOPHYSICS IN UNITED NATIONS PRO-

JECTS, United Nations, New York.

J. M. Brown.

French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology Report No 26, p 651-657, 1970. 7 p, 1 tab.

Descriptors: *Geophysics, *Exploration, *Ground-water, *United Nations, Projects, Reviews, Sur-veys, Governments, Water resources development. Identifiers: Groundwater prospecting.

The United Nations is engaged in conducting large exploration programs in the developing countries throughout the world. Extensive use is made of applied geophysics. The objectives vary but the larger programs are designed to prepare the way for investment by the Government or private sector according to national policy. The geophysical element of these programs usually includes aerial survey followed by ground geophysics together with geological and geochemical surveys. From analysis of the data so obtained further geophysical surveys may be undertaken in order to select drilling targets. Operations include investigations for porphyry copper mineralization, iron ores, potassium deposits and so on. Others are in the field of geothermal energy and in groundwater. Geophysics also features in the establishment of training institutes and in the provision of fellowships. Of the larger programs being undertaken by the United Nations a few are in the final stages and from the analysis of these, sound contributions to economic development can be expected. (See also W70-09392) (Knapp-USGS) W70-09397

APPLIED GEOPHYSICS IN THE NATURAL EN-VIRONMENT RESEARCH COUNCIL GREAT BRITAIN,

Institute of Geological Sciences, London (En-

gland). K. C. Dunham.

French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Report No 26, p 658-666, 1970. 9 p, 1 fig, 39 ref.

Descriptors: *Geophysics, *Exploration, *Surveys, Reviews, Foreign research, Economics, Projects, Research and development, Groundwater, Water resources development.

Identifiers: *United Kingdom.

A short historical review summarizes past activity by United Kingdom organizations in geophysical exploration as applied to economic geology and

groundwater both in and around Britain and in proc grams overseas. The principal methods used are discussed briefly and illustrated by a few more detailed examples. Organizational changes following the formation in 1965 of the National Environment ment Research Council are described, with specia. reference to integration of the former Geological Survey of Great Britain and Overseas Geological Surveys within the new Institute of Geologicals Sciences. A forward glance is directed towards identifying projects suitable for future research by governmental organizations, possibly in collabora-ation with university and industrial groups. (See also W70-09392) (Knapp-USGS) W70-09398

THE USE OF SEISMIC REFRACTION AND GRAVITY METHODS IN HYDROGEOLOGI-L CAL INVESTIGATIONS,

Geological Survey, Raleigh, N.C.; and Northh Carolina Univ., Raleigh.

Gordon P. Eaton, and Joel S. Watkins.

French resume. In: Mining and Groundwater r Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct t 1967, Canada Geological Survey Economic Geolo-gy Report No 26, p 544-568, 1970. 25 p, 16 fig, 77 tab, 91 ref.

Descriptors: *Seismic studies, *Gravity studies, *Aquifers, *Groundwater, *Hydrogeology, Water resources development, Porosity, Water storage, Sediments, Glacial drift, Data collections, Hydrologic data, Mapping, Exploration, Subsurface investigations. Identifiers: Groundwater prospecting.

The capacity of unconsolidated deposits to store water depends on their porosity, thickness and shape; thus geophysical methods that provide information relating to these factors provide techniques for both search and evaluation. Although many factors have a bearing on velocity and density, porosity is a particularly important factor. Low density and low velocity are a direct indication of high total porosity and potential water storage capacity, and hence a useful guide to unconsolidated aquifers, Under ideal circumstances, the seismic method provides a means of determining the three-dimensional geometry of the aquifer, the gross stratig-raphy and local lithofacies variations of the aquifer, and depth to the water-table. The gravity method can be used alone as a reconnaissance tool for evaluating bedrock topography beneath the aquifer in some areas, and locally for quantitative estimates of depth to bedrock. Used with the seismic method or with borehole data, surface measurements of gravity provide a means of determining the average total porosity of the deposit and, in some instances, even a measure of specific yield. (See also W70-09392) (Knapp-USGS)

BOREHOLE GEOPHYSICS AS APPLIED TO

GROUNDWATER, Geological Survey, Denver, Colo.

W. Scott Keys.

French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Cen-tennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology Report No 26, p 598-614, 1970. 17 p, 8 fig, 20

Descriptors: *Borehole geophysics, *Hydrogeology, *Aquifers, Groundwater, Surveys, Data collec-tions, Electrical studies, Exploration, Logging (Recording), Radioactivity, Resistivity, Subsurface investigations, Instrumentation. Identifiers: Groundwater prospecting.

The Water Resources Division of the U.S. Geological Survey is conducting research on the applica-tion of borehole geophysics to groundwater in-vestigations. The various logging techniques include: natural gamma; gamma-gamma; neutron-gamma; neutron-neutron; spontaneous potential; single point, short-, and long-normal resistivity; caliper; sonic velocity; flowmeter; radioactive tracer; fluid resistivity; and gradient and dif-ferential temperature. Geophysical logs can be interpreted in terms of the geometry, resistivity, bulk density, porosity, permeability, moisture content, and specific yield of water-bearing rocks and the source, movement, and chemical and physical characteristics of water. Geophysical logs are often the only means of obtaining information from old wells and lateral extrapolation of geologic and hydrologic conditions. Logging can partially supplant coring. Data obtained from samples become more meaningful when used with geophysical logs because logs provide continuous average values for a volume of material much larger than that of extracted samples. New lightweight logging equipment is economically compatible with present well costs and with the value of water. (See also W70-09392) (Knapp-USGS) W70-09400

GEOPHYSICAL PROSPECTING GROUNDWATER IN THE SOVIET UNION, FOR Moscow State Univ. (USSR).

Moscow State Univ. (USSK).

A. A. Ogilvy.
French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology Report No 26, p 536-543, 1970. 8 p, 8 fig, 7 ref.

Descriptors: *Geophysics, *Surveys, *Ground-water, *Water resources development, Permeability, Storage coefficient, Electrical studies, Seismic studies, Borehole geophysics, Density, Nuclear meters, Electrical well logging, Resistivity, Exploration, Subsurface investigations. Identifiers: USSR, Groudwater prospecting.

Geophysics has been applied to groundwater exploration in the Soviet Union since 1929. The principal groundwater problems dealt with are investigations of permeability and water-bearing properties of rocks, search for groundwater accumulations, and studies of groundwater movement. Electrical prospecting, electrical logging, and to a lesser extent, seismic prospecting are the principal methods used to solve these problems. Geophysical methods are widely used in groundwater studies in permafrost regions covering about 43 percent of the area of the Soviet Union. They are commonly applied in determining the interface between fresh and salt waters near sea shores and particularly in the search for fresh-water lenses that are principal water-supply sources in deserts. (See also W70-0932) (Knapp-USGS)

A REVIEW OF SOME PROBLEMS OF SEISMIC PROSPECTING FOR GROUNDWATER IN SUR-FICIAL DEPOSITS,

Saskatchewan Univ., Saskatoon.

Kenneth B. S. Burke.

French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Cen-tennial Conference at Niagara Falls, Canada, Oct 2011 September 2012 April 2012 Ap

Descriptors: *Seismic studies, *Surveys, *Aquifers, *Hydrogeology, *Groundwater, Water resources development, Water-table, Permeability, Porosity, Sands, Velocity, Data collections, Hydrologic data, Geophysics, Exploration, Subsurface investigations

Identifiers: Canada, USSR, Groundwater prospect-

Seismic prospecting is often used in the search for groundwater supplies in surficial deposits. The usual targets in this search are unconsolidated or semiconsolidated deposits of clastic material, confined by less permeable deposits. Besides the normal limitations of the seismic method, three particular problems confront the seismologist. These

are: (1) the difficulty of generating simple seismic bodily waves in unconsolidated materials; (2) the lack of a definitive relationship between seismic velocity and a particular deposit; and (3) the much greater significance of errors in small-scale seismic investigation. Amplitude and frequency studies are promising in removing some of the restrictions imposed by the lack of velocity contrasts. In one example such studies provided useful information on the identity and porosity of an aquiferous sand in the USSR. However, an attempt to repeat this experiment under similar conditions in Canada failed, probably because of unavoidable changes in shothole characteristics. The possible role of the electroseismic effect in determining permeability is mentioned. (See also W70-09392) (Knapp-USGS)

INTEGRATION OF GEOPHYSICAL METHODS FOR GROUNDWATER EXPLORATION IN THE PRAIRIE PROVINCES, CANADA,

Research Council of Alberta, Edmonton.

D. H. Lennox, and V. Carlson.

French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology gy Report No 26, p 517-535, 1970. 19 p, 6 fig, 4 tab, 44 ref.

Descriptors: *Geophysics, *Surveys, *Grounddevelopment, water, *Water resources development, Hydrogeology, Data collections, Hydrologic data, Seismic studies, Resistivity, Electrical studies, Gravity studies, Aquifers, Grasslands, Geology, Exploration, Subsurface investigations.

Identifiers: Canada, Groundwater prospecting.

In the Canadian prairies, geophysics has had two main uses as an aid in groundwater exploration: delineation of the preglacial drainage pattern and mapping the location and extent of buried permeable deposits of Pleistocene and Recent age. Delineation of the preglacial drainage pattern may involve mapping the elevation of the bedrock surface or simply tracing geophysical anomalies as-sociated with preglacial river courses. Seismic refraction has commonly been used for the former purpose, resistivity and gravity for the latter. Resistivity has also proved suitable for mapping the location and extent of the buried permeable Pleistocene and Recent deposits. Considerable effort has been expended on geophysical exploration for groundwater in the Canadian prairies but comparatively little on critical evaluation of the effectiveness of the various methods in a variety of geologic situations. More case-history studies are required to remedy this deficiency and to provide a more reliable picture of the role of each method as a member of an integrated exploration team. (See also W70-09392) (Knapp-USGS)
W70-09403

INTEGRATION OF GEOPHYSICS AND HYDROGEOLOGY IN THE SOLUTION OF REGIONAL GROUNDWATER PROBLEMS,

Water Planning for Israel Ltd., Tel-Aviv.

Z. L. Shiftan.

French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct-1967, Canada Geological Survey Economic Geology Report No 26, p 507-516, 1970. 10 p, 2 fig.

Descriptors: *Geophysics, *Surveys, *Water resources development, Hydrogeology, Data collections, Hydrologic data, Data processing, Mapping, Water wells, Resistivity, Electrical studies, Gravity studies, Magnetic studies, Exploration, Subsurface investigations. Identifiers: Israel, Groundwater, 1987.

Identifiers: Israel, Groundwater prospecting.

The present worldwide increase in the demand for groundwater is responsible for the growing number of groundwater exploration and development projects of regional size, requiring accuracy in the evaluation of available resources. For this purpose,

an integrated application of geological, geophysical and hydrological methods and test drilling is needed. In such projects, geophysics is employed mainly in coordination with geological studies and drilling, to establish a model of the subsurface structure of the region and the existing aquifers. It also serves as an instrument for the solution of a variety of special hydrological problems, such as groundwater salinity distribution and localization of regions of groundwater flow. (See also W70-09392) (Knapp-USGS) W70-09404

THE ROLE OF GEOPHYSICS IN THE DEVELOPMENT OF THE WORLD'S GROUND-WATER RESOURCES,

Geological Survey, Denver, Colo.

Don R. Mabey.

French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology Report No 26, p 267-271, 1970. 5 p, 5 fig.

Descriptors: *Geophysics, *Surveys, water, *Water resources development, Hydrologic data, Data collections, Hydrogeology, Gravity studies, Seismic studies, Electrical studies, Magnetic studies, Exploration, Subsurface investigations. Identifiers: Groundwater prospecting.

All of the standard airborne, surface, and borehole geophysical methods have found some use in groundwater investigations. Electrical and seismic surveys are the most common surface methods, and electrical and gamma-ray logs the most common borehole methods. However, adequate geophysical support for a diversified groundwater program requires that all of the standard geophysical techniques be available when needed. The trend in groundwater investigations is toward looking at problems on a regional basis rather than to the development of a single well or well field. A properly designed and executed program of geophysics can make a major contribution to programs of this type. The development in recent years of more extensive and better-supported water resource programs has resulted in a greater effort in groundwater geophysics. As the value of fresh water increases, and as societies become more aware of the long-range problems relative to obtaining adequate supplies of fresh water, the need and support for groundwater geophysics will expand. (See also W70-09392) (Knapp-USGS) W70-09405

SEISMIC METHODS IN MINING AND GROUNDWATER EXPLORATION,

Geological Survey of Canada, Ottawa (Ontario).

George D. Hobson.
French resume. In: Mining and Groundwater
Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology Report No 26, p 148-176, 1970. 29 p, 37 fig, 1 tab, 63 ref.

Descriptors: *Seismic studies, *Groundwater, *Surveys, Investigations, Geophysics, Aquifers, Water levels, Data collections, Hydrologic data, Hydrogeology, Instrumentation, Exploration, Subsurface investigations.

Identifiers: Canada, Groundwater prospecting.

Oil prospecting seismic techniques and equipment can be used, with minor adaptation, for problems associated with mineral and groundwater environments. Compact portable seismographs are now available, most of which are used principally in the refraction mode while there are a few that can record reflected events. Most of these portable seismographs can be used with a hammer struck against a steel plate on the ground as a source of energy thus precluding the use of costly drill holes and explosives. Various types of repetitive sources of energy used in oil prospecting could also be used in mineral prospecting. The various portable

Field 07—RESOURCES DATA

Group 7B-Data Acquisition

seismographs and their special adaptabilities or features, repetitive sources for land and marine seismic programs and some field techniques are presented for comparison and discussion. Some applications of shallow seismic techniques are set forth with a few typical field results from projects designed and conducted towards the search for minerals and water. (See also W70-09392) (Knapp-USGS) W70-09406

APPLICATION OF RESISTIVITY METHODS IN MINERAL AND GROUNDWATER EXPLORATION PROGRAMS,

Colorado School of Mines, Golden

George V. Keller.

French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology Report No 26, p 51-66, 1970. 16 p, 18 fig, 2 tab, 24 ref.

Descriptors: *Electrical studies, *Electrical con-Descriptors: *Electrical studies, *Electrical conductance, *Geophysics, *Surveys, *Groundwater, Resistivity, Electrical well logging, Water resources development, Data collections, Hydrologic data, Data processing, Hydrogeology, Porosity, Permeability, Mapping, Water levels, Exploration, Subsurface investigations.

Identifiers: Canada, Groundwater prospecting.

The 'direct-current' resistivity methods have been used for about a half century and have reached a certain degree of maturity. In many respects, particularly in design of field equipment and approach to interpretation of field data, little has changed in the past twenty to thirty years. In other respects, including the design of field programs and the evaluation of resistivity measurements in geologically meaningful terms, rapid advances are currently being made. During the past decade, the electrode arrays used in field surveys have changed, and now, one may select an array which is best suited for a specific problem. For example, the Schlumberger array provides the greatest depth of penetration for n amount of work, while the dipole array provides the greatest safety in working in areas where there is a great deal of culture. Studies of the relationship between resistivity and other rock characteristics, such as porosity, texture, salinity of groundwater and content of ore minerals, have provided a basis for evaluating resistivities once they are measured, as well as a basis for predicting the probable success of resistivity surveys for specific exploration problems. (See also W70-09392) (Knapp-USGS) W70-09407

THE USE OF GRAVIMETER MEASUREMENTS IN MINING AND GROUNDWATER EXPLORA-

Geonautics, Inc., Washington, D.C.

W. E. Strange.

French resume. In: Mining and Groundwater Geophysics//1967, Proceedings of Canadian Cen-tennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology Report No 26, p 46-50, 1970. 5 p, 39 ref.

Descriptors: *Geophysics, *Gravity studies, *Surveys, *Groundwater, *Water resources development, Investigations, Data collections, Hydrologic data, Hydrogeology, Porosity, Density, Cumputers, Data processing, Mapping, Borehole geophysics, Exploration, Subsurface investigations.

Identifiers: Canada, Groundwater prospecting, Borehole gravimeters.

Improvements in the portability, range, calibration, accuracy and drift characteristics of modern land gravimeters provide data of increased accuracy in conjunction with a decrease in time, effort and cost for a survey. The new instruments also make possible the execution of special work such as gravity-gradient surveys, three-dimensional mine surveys and offshore gravity surveys. A more difficult

problem has been the development of gravimeters for use on moving platforms. Much progress has been made on gravimeters for shipboard use but airborne systems are still in the experimental stage. The borehole gradiometer offers real promise for providing porosity estimates in groundwater studies and density estimates in mining work. Computerized field data handling permits rapid data plotting and contouring as well as swift and accurate reductions including the terrain correction, and, in the case of moving platform systems, processing of information from other sensors. Computerized data handling can be conveniently grouped in two categories: separation of local and regional anomalies and the fitting of density models to explain the observed gravity field. A number of techniques for resolving these problems are available and many others are still under consideration. (See also W70-09392) (Knapp-USGS) W70-09408

INTERPRETATION OF GEOELECTRICAL RE-SISTIVITY MEASUREMENTS FOR SOLVING HYDROGEOLOGICAL PROBLEMS,

Federal Earth Research Inst., Hanover (West Ger-

French resume. In: Mining and Groundwater Geophysics/1967, Proceedings of Canadian Centennial Conference at Niagara Falls, Canada, Oct 1967, Canada Geological Survey Economic Geology Report No 26, p 580-597, 1970. 18 p, 24 fig, 23

Descriptors: *Electrical studies, *Aquifers, *Groundwater, *Surveys, Resistivity, Seismic studies, Porosity, Permeability, Hydrogeology, Data collections, Hydrologic data, Exploration, Subsurface investigations.

Identifiers: Groundwater prospecting.

The interpretation of geoelectrical resistivity measurements for hydrogeological problems is substantially determined by the physical parameter of specific electric resistivity. In the treatment of hydrogeological problems we have to deal exclusively with the ionic conductivity of the soil and this, again, depends on the pore or interstitial volume of the rock, on its water saturation and on the electrolytic content of the groundwater. The dependence of the specific resistivity on the electrolytic content of the pore water renders the geoelectrical resistivity method an effective means for fixing the limit between fresh and salty groundwater. The significance of the geoelectrical re-sistivity method is that it is capable, used with the seismic method, to subdivide a horizontally stratified aquifer system. Case histories from humid and arid areas illustrate how, be geoelectrical resistivity measurements, hydrogeological problems may be solved using a suitable combination of the presently available methods of interpretation. (See also W70-09392) (Knapp-USGS) W70-09409

CHAPTER 4: MONITORING THE ENVIRON-

National Academy of Sciences-National Academy of Engineering, Washington, D.C. Environmental Studies Board

Washington, D.C., National Academy of Sciences National Academy of Engineering, Jaunuary 1970.

Descriptors: *Monitoring, *Environment, Institu-tions, Environmental effects, Management, tions, Environmental Planning, Administration.

Identifiers: *Environmental monitoring program, *Environmental quality index, Environmental

The environment cannot be effectively managed without knowing what it is or how it behaves. Accordingly an environmental monitoring program is recommended with a high priority. Such a monitoring program must include at least the following: (1)

Physical and chemical properties of land, air, and Physical and chemical properties of land, air, and a water; (2) Distribution of plants and animals in land, air, and water; (3) Land use, including diversity of purpose; (4) Construction; (5) Noise; (6) Epidemiology of man, animals, and plants; (7)) Evidence of environmental stress, such as tranquilizer consumption and a social behavior; and (8) Aesthetic qualities. Also recommended is an overall environmental quality index which would serve as a management tool in developing priorities among environmental programs. Finally it is recommended that federal programs for comprehensive and systematic monitoring of environmental quality be carried out by an environmental monitoring agency. (See also W70-08929) (Davis-Chicago) W70-09442

COLOR-VELOCITY METHOD IN MEASURING DISCHARGE,

United States Lake Survey, Detroit, Mich Ira M. Korkigian, and Thomas E. Ottenbaker Available from NTIS as AD-706 874, \$3.00 in paper copy, \$0.65 in microfiche. Lake Survey Miscellaneous Paper no MP-70-1, Jun 1969. 34 p.

Descriptors: *Flow measurement, *Fluorometry, *Flow rates, Open channel flow. Identifiers: St. Clair River, Michigan.

This is the first attempt by the U.S. Lake Survey in applying fluorescent dyes for measurement of the discharge in an open channel. The purposes of the tests were: (1) to become familiar with the instru-mentation and the use of fluorescent dyes, and (2) to compare the results of the dye method with stan-dard current meter methods. Five tests were run, with three being run simultaneously with standard methods. W70-09449

RHEOLOGICAL AND ULTIMATE STRENGTH PROPERTIES OF COHESIVE SOILS,

Kentucky Dept. of Highways, Lexington. Div. of Research.

For primary bibliographic entry see Field 08D. W70-09452

STUDY OF THE USE OF AERIAL AND SATELLITE PHOTOGRAMMETRY FOR SURVEYS IN HYDROLOGY, National Environmental Satellite Center, Washing-

ton, D.C.
Everett H. Ramey.

Available from NTIS as PB-191 735, \$3.00 in paper copy, \$0.65 in microfiche. ESSA Technical Memorandum, NESCTM-14, Mar 70, 31 p.

Descriptors: *Hydrography, Satellites, *Data collections, *Remote sensing. Identifiers: Satellite photogrammetry.

The study was undertaken to explore possible applications of photogrammetry in problems of hydrology. The critical factors in the use of satellite photographs are included as part of this study. Also the various physical and economic factors in the use of aerial photogrammetry are analyzed in the measurement of both snow cover and snow depth. It was concluded that the required accuracy can be It was concluded that the required accuracy can be attained, but sometimes the cost would be prohibitive. The use of aerial photography and other related sensors to some other problems in hydrology are considered. Here it seems that such remote sensing from aircraft offers the hydrologist a feasible means to map some special events where detailed mapping is needed. W70-09454

7C. Evaluation, Processing and Publication

OPTIMAL RESOURCE ALLOCATION AND SOME TECHNIQUES OF OPTIMIZATION, Purdue Univ., Lafayette, Ind.

For primary bibliographic entry see Field 05G. W70-09182

DIGITAL ANALYSIS OF AREAL FLOW IN MULTIAQUIFER GROUNDWATER SYSTEMS:
A QUASI THREE-DIMENSIONAL MODEL,
Geological Survey, Washington, D. C. For primary bibliographic entry see Field 02F. W70-09197

PROCESSING DATA FOR CHANNEL NET-WORKS,

IBM Watson Research Center, Yorktown Heights,

N.1. S. Smart. Water Resources Research, Vol 6, No 3, p 932-936, June 1970. 5 p, 5 fig, 1 tab, 7 ref.

Descriptors: *Drainage patterns (Geologic), *Statistical methods, *Path of pollutants, *Geomorphology, *Data processing, Topography, Data collections, Statistics, Stochastic processes, Markov processes, Probability, Digital computers. Identifiers: Drainage network topology, Topology.

The binary digit representation of channel network topology is proposed as an aid to data handling for channel networks. Examples of its use are drawn from the fields of water pollution control and geomorphology. (Knapp-USGS) W70-09204

AQUIFER SIMULATION ON SLOW TIME RE-SISTANCE-CAPACITANCE NETWORKS, Birmingham Univ. (England). Dept. of Civil En-

gineering.
For primary bibliographic entry see Field 02F.
W70-09226

FLOOD PLAIN MAPPING BY THE U. S. GEOLOGICAL SURVEY,

Geological Survey, Champaign, Ill. For primary bibliographic entry see Field 06F. W70-09255

A THEORETICAL ANALYSIS AND NUMERICAL SOLUTIONS OF UNSATURATED FLOW

IN SOIL, Gifu Univ. (Japan). Faculty of Agriculture. For primary bibliographic entry see Field 02G. W70-09305

LINEARIZATION TECHNIQUE FOR THE

A LINEARIZATION TECHNIQUE FOR THE STUDY OF INFILTRATION, Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industrial

For primary bibliographic entry see Field 02G. W70-09307

SOLUTIONS OF THE NON-LINEAR DIFFU-SION EQUATION WITH A GRAVITY TERM IN

HYDROLOGY,
Technion - Israel Inst. of Tech., Haifa; and California Univ., Berkeley.

For primary bibliographic entry see Field 02G. W70-09308

SOME NUMERICAL METHODS FOR SOLVING PROBLEMS OF NON-STEADY SEEPAGE IN NON-HOMOGENEOUS ANISOTROPIC SOILS, All-Union Scientific and Research Inst. Hydrotechnics and Reclamation (USSR). For primary bibliographic entry see Field 02G. W70-09309

APPLICATION OF REGRESSION ANALYSIS IN

HYDROLOGY,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
N. Tywoniuk, and K. Wiebe.

Canada Department of Energy, Mines and Resources Inland Waters Branch, Technical Bulletin No 24, 1970. 18 p, 2 fig, 9 ref.

Descriptors: *Statistical methods, *Regression analysis, Correlation analysis, Data processing, Hydrologic data, Statistical models, Mathematical studies.

Identifiers: Canada.

The use of regression analysis as one of the statistical tools in the field of hydrology is explained. Its main applications are in the study of the relationship between two or more hydrologic variables and the investigation of dependence between the successive values of a series of hydrologic data. Hydrologic data rarely, if ever, completely meet the requirements or assumptions on which the regression method is based. Its main difference from correlation analysis should be emphasized: the regression method does not require that the variables be normally distributed as does the correlation method. Graphical and analytical regression analyses are among the most useful statistical tools in hydrology. The use of the digital computer considerably reduces the work of the analytical analysis making it possible to include variables which would otherwise go unnoticed. The analytical analysis must be done with care and with the help of graphical plots, otherwise it is possible to get nonsense correlations or to draw unwarranted inferences from the data. (Knapp-USGS)

08. ENGINEERING WORKS

8A. Structures

OKLAHOMA EX REL PHILLIPS V GUY F AT-KINSON CO (INJUNCTION AGAINST DAM CONSTRUCTION).

For primary bibliographic entry see Field 06E. W70-09071

AN EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM DESIGN,
Johns Hopkins Univ., Baltimore, Md. Dept of Sanitary Engineering and Water Resources. John C. Geyer, and John J. Lentz. Final Report of the Residential Sewerage Research

Report of the Federal Housing Administration Technical Studies Program, (1964). 115 p, 24 fig, 25 tab, 7 ref.

Descriptors: *Sewers, *Sanitary engineering, *Hydraulic design, *Municipal wastes, *Maintenance, *Operating costs, Infiltration, Root system, Data collections, Collapse, Pumping plants, Unbowing collections

Urbanization.
Identifiers: *Sanitary sewers, *Sewer design,
*Sewer design problems, *Flow estimates, Sewage
pumping stations, Data collection, Residential
sewer systems, Sewer stoppages, Engineering design.

Describes the most extensive coordinated investigation into the functioning of sanitary sewers ever conducted, according to the authors. Operational, maintenance, and design problems confronting sewer designers were studied using field data collected in four U. S. communities: Springfield, Missouri; Anaheim, California; Bradenton, Florida; and Baltimore County, Maryland. The executive for the service of the servic tensive four-year data collection program was or-ganized and coordinated by Johns Hopkins personnel. The data was used to study the nature and functioning of sanitary sewerage systems serving residential communities. It was found that fewer sewer blockages result when grades are moderate, and that more blockages occur at the upper ter-minals of the sewer lines. The distance between manholes appears to have little influence on the costs of relieving stoppages. The maximum man-hole spacing is limited by the reach of sewer clean-ing equipment. The basic causes of sewer maintenance problems are tree roots, accumulations of

debris in the absence of roots, and, in areas having cohesionless soils, cave-ins. Infiltration of groundwater and stormwater was found to be excessive and unpredictable in all systems studied, making the use of estimated domestic flow quantities meaningless for design purposes. Limited data on costs of operating and maintaining sewage pumping stations are reported and evaluated. Many tables, illustrations and charts, useful in sanitary sewer design, are included. (Poertner) W70-09185

ELECTRONIC COMPUTER PROGRAM FOR HYDRAULIC ANALYSIS OF BOX CULVERTS (BPR PROGRAM HY-3), Bureau of Public Roads, Washington, D.C.

J. R. Link, R. C. Tennent, and L. J. Harrison.

Available from NTIS as PB-191 356, \$3.00 in

paper copy, \$0.65 in microfiche. Supersedes PB-168 717. 5th Printing, Sep 67. 51 p, 1 fig, 3 tab.

Descriptors: *Roads, *Culverts, *Drainage systems, Drainage programs, Hydraulic design, Hydraulic engineering, Computer programs, Civil engineering, Pipes.
Identifiers: *Box culverts.

This program is used for the hydraulic analysis of box culverts for given hydrological data and site conditions. The program determines the size of culvert which satisfies the hydrological data and site conditions for inlet control and outlet control. The output includes: number of barrels, culvert width, culvert height, headwater and outlet velocities. Outlet control calculations make use of backwater calculations. W70-09445

8B. Hydraulics

ABOUT THE ROUGHNESS PROBLEM IN PIPES AND TUNNELS, Technische Hochschule, Munich (West Germany).

P. G. Franke.

13th Congr Int Assn Hydraul Res, Proc Vol 2, p 349-355, Aug-Sept 1969. 7 p, 3 fig, 13 ref.

Descriptors: *Pipes, *Tunnels, Surface properties, *Tunnel hydraulics, *Roughness coefficient, *Roughness (Hydraulic), Energy losses, Sands, Bituminous materials, Hydraulics, Operations, Foreign research, Grain sizes.
Identifiers: *Friction factors, *Pipe linings, Friction

coefficient (Hyd), *Resistance coefficients, Germany, *Rugosity.

The effect of variations in surface roughness in pipes and tunnels is demonstrated, and the difference between technical roughness and equivalent sand grain roughness is explained. The cause and effect of alterations in effective roughness of closed conduit linings are variable. Apart from the quality of water and the height of the roughness elements, the texture and pattern are particularly important. Especially remarkable is the ripple-like roughness that is formed by certain quality waters. Compared with the equivalent sand grain roughness of equal height, much larger fric-tion factors result. The simulated sand roughness is to be considered as a parameter for the roughness is conditions only; in analogy, the relative roughness is also a parameter. Case histories of various pipe installations in Europe are discussed. (USBR) W70-09011

ZONE LENGTHS OF AIR EMULSION IN WATER DOWNSTREAM OF THE RING JUMP IN PIPES,

Research Inst., Prague Hydraulic zechoslovakia). K. Haindl.

13th Congr Int Assn. Hydraul Res, Proc Vol 2, p 9-19, Aug-Sept 1969. 11 p, 4 fig, 7 ref.

Field 08—ENGINEERING WORKS

Group 8B-Hydraulics

Descriptors: *Pipes, *Pipe flow, Hydraulic jump, Turbulent flow, Flow, Turbulence, *Air, Hydrau-lics, Cones, Valves, Water treatment, Energy dis-sipation, Aeration, *Reaches (Distance), Deaeration, Fluid flow

Identifiers: *Ring jump, Air-water mixtures.

Basic properties of ring jump in closed conduits are discussed. The hydraulic phenomenon in which the water ring flowing along pipe walls enlarges into a flow through the whole profile is called ring jump. It manifests itself, as does the usual hydraulic jump, by vortices and high turbulence flow, in this case by the formation of characteristic vortices in planes drawn through the pipe axis. Its occurrence is sub-ject to the equality of the flow pressure force downstream of the jump and the dynamic force of the moving ring. The ring jump forces air from the space in front of the jump into the pressure flow following the jump and mixes all fluid components into homogeneous flow. Within the intense turbulent flow following the jump in the air turbulence zone in the liquid and also in the vortices of the jump, both fluid comoponents influence each other very effectively. This phenomenon may be applicable to conditioning and treatment of water, and for dissipation of kinetic energy from dispersion cone valves and the aeration of outflowing water. (USBR) W70-09022

HYDRAULIC DESIGN FOR CHECK METHOD OF IRRIGATION,

Punjab Agricultural Univ., Hissar (India). For primary bibliographic entry see Field 03F. W70-09136

BUOYANT PLUMES AND THERMALS,

Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics. For primary bibliographic entry see Field 05B. W70-09168

TURBULENT DIFFUSION IN A STABLY STRATIFIED SHEAR LAYER.

Colorado State Univ., Fort Collins. Fazal H. Chaudhry, and Robert N. Meroney. Technical Report C-0423-5 Sept. 1969. 185 p, 61

Descriptors: *Diffusion, *Thermal stratification, *Boundary layers, *Tunnels, *Simulation analysis, *Air pollution, Turbulence, Diffusivity, Velocity, Fluid Mechanics, Radioisotopes, Theoretical analysis, Laboratory tests.

Identifiers: *Gaussian effect, *Similarity theory, *Three dimensional analysis, Ground level concentrations, Atmospheric surface layer.

Diffusion of a passive substance released from a continuous point source in a stably stratified shear layer is investigated both theoretically and experimentally. Using Monin-Obukhov's velocity profile mentary. Using Monin-Outknov's velocity profile and assuming a vertical eddy diffusivity which is a power function of the stability parameter, z/L, the Eulerian turbulent diffusion equation is solved to obtain expressions for vertical and longitudinal velocities of the center of mass of a cloud in the constant stress region. These expressions give physical substance to those suggested by Gifford (1962) and Cermak (1963 as intuitive extensions of Batchelor's Lagrangian similarity theory. A stably stratified shear layer was produced by heating the air and cooling the wind tunnel floor. Detailed observations of the diffusion field, downwind ground and elevated point sources, have been made using Krypton-85 as a tracer. The construction observations of the diffusion of the construction observations of the diffusion of the construction observations of the diffusion of the construction of the diffusion of centration characteristics obtained from diffusion experiments show excellent agreement with those observed in the atmosphers. The data compares well with the predictions of similarity theory. It appears that the parameters evaluated in the field by Klug (1968) hold also for the wind tunnel data. The data support the assumption of a Gaussian effect of source height, for elevated releases, on the ground level concentration. (Hsieh-Vanderbilt)

OPERATING FORCES ON SECTOR GATES UNDER REVERSE HEADS; HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

N. R. Oswalt.

Sponsored by U.S. Army Engineer District, New Orleans. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report H-70-2, March 1970. 13 p, 6 tab, 8 pl.

*Hydraulic models. Descriptors:

*Floodgates.
Identifiers: *Sector gates, *Operating forces, Reverse head (Fluid mechanics).

In southern Louisiana several existing sector gate locks have experienced operational difficulties during reverse heads of 1.0 ft or greater. The sector gate would stall at a small opening, resulting in delay at lockage or breakdown in machinery. A 1:20-scale model with one set of gate leaves was constructed to measure forces acting on sector gate during reverse heads, develop feasible modifications for elimination of stall at existing structures, and test a gate of new design for use in future structures. From past experiences and observation of flow in the model, it was considered that head differentials across the members of the gate near the nose of each leaf probably caused a major portion of the load on the gate machinery. Three modifications designed to reduce head differentials across the members near the gate nose were tested; type 2 gave the greatest force reduction for the least prototype change. Use of shorter seal brackets attached to skin plate was also recommended. (Spivey-Waterways Experiment Station) w70-09177

WAVE ACTION AND BREAKWATER LOCATION, VERMILION HARBOR, OHIO; HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

C. W. Brasfeild.

Sponsored by U.S. Army Engineer District, Buffalo. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report H-70-5, May 1970. 18 p, 6 tab, 4 photo, 6 pl, 7 ref.

Descriptors: *Breakwaters, *Hydraulic models, *Waves (Water), Shore protection. Identifiers: *Vermilion Harbor, Ohio; Lake Erie.

Model investigation was made to test and develop plans for improvement proposed for reducing wave heights at the harbor entrance and in the outer reaches of Vermilion River channel. The 1:75-scale model, molded in cement mortar, reproduced ap-proximately one-half mile of the Lake Erie shoreline on each side of harbor entrance, about 3600 ft of the river channel, several boat mooring lagoons off the main channel, and sufficient underwater contoured area to permit accurate simulation of storm-wave action. A 52-ft-long wave machine and electrical wave height measuring and recording apparatus were used. It was concluded that an offshore breakwater, approximately 700 ft long, installed perpendicular to entrance channel center line and 200 ft from outer end of the existing east channel pier would provide adequate protection from wave action. (Spivey-Waterways Experiment Station) W70-09178

SPILLWAY AND OUTLET WORKS, ROWLESBURG DAM, CHEAT RIVER, WEST VIRGINIA; HYDRAULIC MODEL INVESTIGA-

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

J. H. Ables, and M. B. Boyd.

Sponsored by U.S. Army Engineer District, Pitt-sburgh. U.S. Army Engineer Waterways Experi-ment Station, Vicksburg, Mississippi, Technical Report H-70-7, June 1970. 22 p, 6 tab, 7 photo, 31

Descriptors: Concrete dams, *Outlet works, *Spillways, Stilling basins, *Hydraulic models, *Open channel flow, *Sluices.
Identifiers: *Rowlesburg Dam.

Tests were conducted on a 1:20-scale sluice intake model and a 1:60-scale comprehensive model to study hydraulic performance of spillway, to verify adequacy of spillway and sluices for both separate and combined flow operation, to verify and/or to refine the stilling basin design, to study approach and exit channel conditions, to evaluate the effectiveness of the water-quality control tower and sluice in selectively withdrawing water from desired levels, and to investigate pressures in the sluice intake. The stage-discharge curve for combined un-controlled spillway and sluice flow developed from model test results is in close agreement with computed curves. Capacity of structure is adequate. 12 stilling basin designs were tested, and one recommended over the others. Two schemes for selective withdrawal from top 15 ft of reservoir fell short of desired operating characteristics. (Spivey-Waterways Experiment Station) W70-09180

TURBULENCE MEASUREMENTS NEAR THE: FREE SURFACE OF AN OPEN CHANNEL. FLOW,

Illinois Univ., Urbana. For primary bibliographic entry see Field 02E. W70-09208

EFFECTS OF EFFLUENT AND INFLUENT SEEPAGE ON THE HYDRODYNAMIC FORCES ACTING ON AN IDEALIZED NONCOHESIVE SEDIMENT PARTICLE,

Utah State Univ., Logan. Dept. of Civil Engineer-

ing.
M. V. Panduranga Rao.

Utah State University, PhD Dissertation, Dep of Civil Engineering, 1969. 133 p, 34 fig, 11 tab, 59 ref, 2 append. NSF Research Grant GK-913.

Descriptors: *Erosion, *Open channel flow, *Seepage, *Alluvial channels, *Hydraulic models, Viscosity, Hydrodynamics, Hydrostatic pressure, Flow around objects, Reynolds number, Instrumentation, Flumes, Model studies, Hydraulic tation, Flumes, similitude. Identifiers: Hydrodynamic lift.

The effects of effluent and influent seepage on the hydrodynamic forces acting on an idealized noncohesive sediment particle were investigated experimentally. An attempt was made to dynamically simulate the hydrodynamic conditions prevailing near and within an alluvial channel bed by using the shear velocity Reynolds number and the seepage Reynolds number as modeling parameters. In order to achieve dynamic similarity between the labora-tory sediment particles (which are 3.75 inches in diameter) and the natural sediment particles (size less than 1 mm) the model fluid used had a dynamic viscosity approximately 200 times greater than that of water. The laboratory flume used had provision for introducing seepage along a 5-foot portion of the 15-ft long bed. A parallel-link straingage dynamometer was designed to simultaneously measure drag and lift forces for different channel flow conditions with and without the effects of effluent or influent seepage. A range of shear velocity Reynolds number of 15 to 140 was covered. (Knapp-USGS) W70-09410

8C. Hydraulic Machinery

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION SOLID STATE-STATE HVDC ASYNCHRONOUS TIE INSTALLATION,

New Brunswick Electric Power Commission, Fredericton; Canadian General Electric Co. Ltd., Peterborough (Ontario); and General Electric Co., Schenectady, N.Y.
F. H. Ryder, C. M. Stairs, and G. D. Breuer. Amer Power Conf, (Paper) Chicago, Ill, Apr 1970. 24 p, 6 fig, 7 ref.

Descriptors: Transmission (Electrical), *Direct current, *Converters (Electrical), Rectifiers, Alternating current, Economics, Electric power, Bus (Electrical), *Semiconductors, Electric cables, Reliability, Electronic equipment, Electric insulation, Coordination, Transmission lines.

Identifiers: *Solid-state valves, *Interties, *Thyristors, Outages, Interconnected systems, New Brunswick, Canada, System stability (Elect).

Canada's New Brunswick Eel River HVDC Converter Station is the first solid-state hvdc system in the world and is important to connected power systems and future applications of hvdc. The project is in the design phase, with commercial opera-tion scheduled for Oct 1, 1972. Many features of the installation use solid-state valves composed of series and parallel-connected thyristors (siliconcontrolled rectifiers) differing from present hvdc systems. The installation will provide a nonsynchronour, 2-directional tie between 2 utility systems with all d-c equipment at one location. Rated at 320 mw, 80 kv dc, the converter station incorporates all the features of an hvdc system with the simplifications of all controls at one location and the absence of a d-c line. The power rating of 320 mw is a significant undertaking of importance to the power systems involved. The installation opens the way to other applications for hvdc transmission exploiting solid-state technology, including configurations of overhead lines and cables, and wider use of controlled transmission links and multiterminal hyde systems. (USBR) W70-09012

CATHODIC PROTECTION OF THE BON-NEVILLE POWER ADMINISTRATION'S 34.5 KV SAN JUAN ISLANDS CABLE, Bonneville Power Administration, Portland, Oreg.

A. Stanley Capon.

Nat Assn Corros Eng, 26th Annu Conf, (Paper 10) Philadelphia, Pa, Mar 1970. 5 p, 7 fig, 5 ref, ap-

Descriptors: *Cathodic protection, *Electric cables, Corrosion, Tides, *Electric potential, Deterioration, Electric power, Transmission (Electrical), Magnetic fields, Electrodes, Sea water, Anodes, Washington.

Identifiers: San Juan Islands, Wash, *Submarine cables, Corrosion currents, Ground currents, Protective coverings, Bonneville Power Admn.

In 1951, the Bonneville Power Administration installed the first 3-conductor, galvanized armored submarine power cable between Fidalgo, Decatur, and Lopez Islands. Each conductor is 300 mcm and has a capacity of about 20,000 kw. Experience gained during operation of the first cable prompted double armoring of a portion of the second cable installed in 1966. The new cable has 3 conductors, each 500 mcm, and is rated at 34.5 kv with a 35,000-kw capacity. The cable armor and method of cathodic protection for the second cable are discussed. Problems pertaining to the cable operation are reviewed, and an analysis of cable armor potential is given. (USBR)
W70-09013

INTERNAL CATHODIC PROTECTION OF WATER COOLED PLANT, Corrosion and Welding Engineering Ltd. (Great

Britain).

R. A. Lowe, and J. W. L. F. Brand.

Nat Assn. Corros Eng, 26th Annu Conf, (Paper 31) Philadelphia, Pa, Mar 1970. 4 p, 3 fig, 1 tab.

Descriptors: Corrosion, *Corrosion control, Foreign design practices, *Cathodic protection, *Anodes, Titanium, Platinum, Cooling water, Saline water, Sea water, *Heat exchangers, Automatic control, Maintenance, Cast iron, Water cool-

ing. Identifiers: Great Britain, Condenser tubes.

Internal cathodic protection systems can be designed to cover all requirements for sea watercooled plants by using a continuous-strip titanium anode platinized on one side. Advantages of the anode include: greatly reduced current density and operating voltage, improved throwing power, lower gross current requirement, reduced current loss to close cathode, and easy cutting and fitting. Installation of an experimental cathodic protection system in a nuclear power station condenser water box is discussed. Saline cooling water flows into one-half of the first water box, through one-half of the tube stack into the second water box, reverses direction to flow through the second half of the first box, and then to discharge. Automatic control of potential is used to compensate for changes in operating conditions from variations in salinity, oxygen content, velocity, temperature, coating efficiency, and surface condition. Special requirements for small boxes and application of cathodic protection to boxes already graphitized are discussed. An effective method for box repair is given, allowing for complete graphite removal and cathodic protection with no fear of losing the box. (USBR) W70-09014

1969 HVDC STRAY CURRENT TESTS ON UN-

DERGROUND TELEPHONE CABLES, Pacific Telephone and Telegraph Co., Pasadena, Calif.; and General Telephone Co. of California, Santa Monica.

H. G. Corbett, and James P. Davey.

Nat Assn. Corros Eng, 26th Annu Conf, (Paper 24) Philadelphia, Pa, Mar 1970. 6 p, 5 fig, 3 tab, 3 ref.

Descriptors: *Corrosion, Corrosion control, *Extra high voltage, Field tests, *Direct current, Electrodes, *Telephones, Polarity, Extra long distance, Instrumentation, Electric potential, Electric cur-

Identifiers: *Ground currents, *Buried cables, Southern California, Pacific Northwest-Southwest Intertie, Corrosion currents, Service life.

The 750-kv d-c Pacific Northwest-Southwest Intertie line, to be completed early in 1970, has been of concern to corrosion engineers. Since 1963, when the power system was first considered, the Pacific Coast telephone companies have been conducting tests in Southern California to determine whether there will be serious corrosion effects on underground telephone cables from the hvdc system. Preliminary tests show that cables quite remote from the hvdc ground electrode as well as those in close proximity may be influenced by the system. The degree of influence may not be predictable because any change in apparent earth resistivity, other stray currents, or change in polarity of the hvdc electrodes could change the environment enough to change the severity. Data collected from many diversified locations during these low current tests indicate that 15- to 20-min intervals of high earth current between the hvdc electrodes will not cause any more generalized type corrosion than normal telluric currents. Cables close to electrodes and cables that connect with remote areas are candidates for surveillance. Existing cables and new cables placed within built-up areas would be expected to have a normal service life. (USBR) W70-09015

INSULATION LEVELS OF DC FILTER REACTORS AND RESISTORS FOR HVDC POWER TRANSMISSION, Bonneville Power Administration, Portland, Oreg.

Narain G. Hingorani, and Stig A. Annestrand. Inst Elec Electron Eng Trans Power App Syst, Vol PAS-89, No 4, p 610-618, Apr 1970. 9 p, 18 fig, 3

Descriptors: *Extra high voltage, *Direct current, *Filters, Costs, Converters (Electrical), *Lightning arresters, *Electric insulation, *Resistors, Transmission (Electrical), Capacitors, Inverters, Faults (Electrical), *Electric reactors, Bridges (Electric), Transients, Electric potential.

Identifiers: Protection (Electrical), Harmonics, Overvoltage, Spark gaps, Flashover, Switching surges.

Insulation of reactors and resistors in the harmonic filter circuits on the d-c side of an hvdc converter station is discussed. The cost of the reactors and resistors is dependent on insulation levels, and could be a substantial part of the total filter costs if insulation levels are comparable to the insulation level of the d-c bus bars. Providing separate arresters across the reactors and resistors is essential because the d-c line arrester does not provide adequate protection for the components. By diligent use of arresters, the insulation levels and costs of the components can be reduced. Arrester duties are small compared to the capabilities of standard a-c arresters. In fact, the arresters would suppress transients on the d-c bus and would reduce the number of d-c arrester operations and assist the d-c arrester in arc quenching. A method of determining appropriate protective levels is presented (USBR) W70-09016

PREDICTION OF RELIABILITY AND AVAILA-BILITY OF HVDC VALVE AND HVDC TER-MINAL.

General Electric Co., Philadelphia, Pa.; and Power Technologies, Inc., Schenectady, N.Y. Charles R. Heising, and Robert J. Ringlee

Inst Elec Electron Eng Trans Power App Syst, Vol PAS-89, No 4, p 619-624, Apr 1970. 6 p, 3 fig, 1 tab, 10 ref, disc.

Descriptors: *Extra high voltage, *Direct current, Descriptors: *Extra high voltage, *Direct current, *Converters (Electrical), *Transmission (Electrical), Rectifiers, Reliability, Costs, *Electronic equipment, Design, Failure (Power), Forecasting, Valves, Analysis, Field data.

Identifiers: *High voltage, *Terminal facilities (Elect), Outages, Electric utilities.

A high-voltage direct-current terminal using silicon-controlled rectifiers (SCR's) contains several thousand electronic components. An availability and reliability prediction was made for an hvdc terminal containing SCR's for use in cost-reliability tradeoff decisions in designing the terminal to assure that the hvdc terminal would be designed adequately. This prediction was made using published failure rates for the electronic equipment. Published failure rates and outage duration times were used to such a-c equipment as power transformers and power circuit breakers. Field failure rate data were used for the SCR's. Estimates were used for the time required to replace electronic equipment in order to restore service. The approach used in these analyses is described, and the weakest links are identified and discussed. Silicon controlled rectifiers can be used for hyde transmission because the system is designed to be fail safe when one or more SCR's fail. (USBR) W70-09017

TRANSIENT OVERVOLTAGE ON A BIPOLAR HVDC OVERHEAD LINE CAUSED BY DC LINE FAULTS,

Bonneville Power Administration, Portland, Oreg.

Narain G. Hingorani. Inst Elec Electron Eng Trans Power App Syst, Vol PAS-89, No 4, p 592-610, Apr 1970. 19 p, 31 fig, 15 ref, disc.

Descriptors: *Direct current, *Faults (Electrical), Transients, Costs, Extra high voltage, Capacitors, Digital computers, *Transmission lines, Lightning, Lightning arresters, Bibliographies, Simulation, Filters, Converters (Electrical), Frequency, sistance, Electrical coronas, Electric insulation. Identifiers: *Overvoltage, High voltage, *Bipolar transmission lines, Protection (Electrical), Terminal facilities (Elect), Flashover.

Digital programs are used to investigate the overvoltages induced in one pole of a bipolar hvdc overhead line caused by a line-to-ground fault on the

Field 08-ENGINEERING WORKS

Group 8C-Hydraulic Machinery

other d-c pole. Various digital tests are performed, paying particular attention to the nature of d-c line termination at the converter stations, including filter circuits and a surge capacitor. The terminal that looks inductive to a wavefront coming from the d-c line is undesirable because it would cause high overvoltages at the terminal of the unfaulted pole. In order to reduce the risk of developing a double-pole outage from a single-pole fault eliminating the surge capacitor is desirable, if a suitable d-c lightning arrester can be designed. Tests are presented in stages to isolate the effects of fault resistance, grid control, and line resistance Results indicate necessary restraints on the dv-dt line fault detection to avoid operation of this protection in the unfaulted pole. Has 15 references. W70-09018

SWITCHING-SURGE CONSIDERATIONS IN UHV TRANSMISSION LINE DESIGN,

Southern California Edison Co., Los Angeles; and General Electric Co. Pittsfield, Mass. Fred R. Klumb, and James J. LaForest. Amer Power Conf, (Paper) Chicago, Ill, Apr 1970. 11 p, 4 fig, 1 tab 12 ref.

Descriptors: *Transmission lines, Research and development, Electrical insulators, Test facilities, Design, Test procedures, Contamination, Electric insulation, Polarity, Bundled conductors, Transmission towers.

Identifiers: *Switching surges, *Ultra high voltage, Flashover, Air gaps, Test results, Lightning surges, Project UHV, *Switching.

Ultra-high-voltage (uhv) research at Project UHV has demonstrated that uhv transmission lines can be constructed to withstand expected switching surges for 1500-kv transmission. Switching-surge studies at Project UHV are the continuation of research undertaken by the industry over many years, now given new life because of 345- to 765-kv transmission systems. Field and transient network analyzer studies showed that airgap spacings required to withstand switching surges were governing because as voltages and spacings were increased, lighning and 60-hz requirements became less important to switching surges for tower air gaps. Recently the trend has been changed where search in the 60-hz strength of contaminated insulator string strength suggests significant nonlinear effects in the uhv range across porcelain supports. Facets of the Project UHV switching-surge research program are reviewed, available uhv results are given, several important findings relative to line design are detailed, and a view of what is needed in this area as the new decade begins is presented. (USBR) W70-09021

FLOW OF ENTRAINED AIR IN CENTRIFUGAL

Nagoya Univ. (Japan); Toyoda Coll. of Technology (Japan); and Mitsui Ship Building Co., Okayama (Japan)

Hakaru Suehiro, Tsuyoshi Isaji, and Mitsukiyo Murakami.

13th Congr Int Assn. Hydraul Res, Proc Vol 2, p 71-79, Aug-Sept 1969. 9 p, 16 fig, 1 tab, 2 ref.

Descriptors: *Centrifugal pumps, *Air entrainment, Experimental data, Pump testing, *Performance, Impellers, Flow characteristics, Air, *Flow, Losses, Test procedures, Specific weight, Foreign research, *Pumps. Identifiers: *Air admission, Air bubbles, Japan,

Test results, Flow patterns.

Entrained air in centrifugal pumps and its effect on pump performance were investigated. Three types of centrifugal pumps were used during the experiment in which known volumes of air were admitted to the suction side of a pump, and pump per-formance measured. Results show that pump capacity was reduced as the volume of entrained air increased. When the volume of entrained air on the pump suction side exceeded 15% of the water volume, every pump lost its prime. Entrained air is broken by the pump impeller into nearly uniform diameter bubbles ranging in size from 0.2 to 0.4 mm. Bubble size decreases as pump speed increases; the point of entrance of air bubbles and bubble size have little effect on pump performance. Work necessary to discharge entrained air constitutes the main loss in the pump with air admission. Different-type pumps have nearly the same characteristics for air admission. (USBR) W70-09023

RAPID REVERSAL OF SAN LUIS PUMPING-GENERATING UNITS,

Bureau of Reclamation, Los Banos, Calif.; and Bureau of Reclamation, Denver, Colo. R. G. Stroh, B. G. Seitz, and L. W. Lloyd. Trans (Paper 69 TP 807 - PWR), Inst Elec Electron Eng/Amer Soc Mech Eng Joint Power Generation Conf, Charlotte, N C, Sept 1969. 8 p, 9 fig, 2 tab, 5

Descriptors: Power system operations, Time, *Pump turbines, Pumping, Hydroelectric plants, Hydroelectric power, Pumping plants, California, Efficiencies, Failure (Power), Pumped storage. Identifiers: *Rapid reversal, *San Luis Pumping-Generating, Reverse flow, *Reversible turbines, Power system stability, *Pump-generators.

A proposal to reverse the San Luis Pumping-Generating Units from pumping to generating in seconds rather than the design time of 20 min was first made when the plant was nearly operational. An evaluation of the electrical, mechanical, and hydraulic duties on the units and the associated equipment showed that no abnormal stress for the proposed rapid reversal existed. Extensive control modifications were made on one of the units, permitting a series of tests that have verified the feasibility of the rapid reversal mode. Reversals from pumping to generating take from 40 sec at low head to 27 sec near the maximum head. One major advantage of this rapid reversal will be system support in the case of decaying system frequency Other operational advantages are also seen. The rapid reversal mode may be suitable in part for more conventional pump-storage installations. (USBR) w 70-09034

CALCULATION OF RADIO NOISE LEVEL FOR THE DESIGN OF AC POWER TRANSMISSION LINES

Central Research Inst. of Electric Power Industry, Tokyo (Japan). Y. Sawada.

Elec Eng Jap, Vol 89, No 9, p 86-96, 1969. 11 p, 14 fig, 5 tab, 20 ref, append.

Descriptors: *Radio interference, *Transmission lines, Design, Foreign research, Rain, Calculations, Electric fields, *Weather, Bibliographies, Atmospheric precipitation, Conductors, Extra high voltage, *Electrical coronas.

Identifiers: Japan, Electric conductors, Test transmission lines, Test Shiobara Test Lines. Test results, Ultra high voltage,

Based on experimental studies, and using results of studies relating to radio noise levels on in-service transmission lines to the levels on experimental lines, a method of calculating transmission line radio noise in clear and rainy weather has been developed. The method differs from methods proposed in the past, and is based on statistical analysis of radio noise characteristics. Formulas are presented for calculating the radio noise level caused by conductor corona on transmission lines during fair and rainy weather conditions. The relation between precipitation rate and radio noise level is based on results obtained on the 600-ky Shiobara Test Lines in Japan. The application is intended for design of transmission lines, especially for selection of the conductor size based on a given geometrical arrangement. Has 20 references. W70-09038

IMPULSE DISCHARGE ON CONTAMINATED)

Nagasaki Univ. (Japan); Kagoshima Univ. (Japan); and Kyushu Inst. of Tech. (Japan). H. Matsuo, Y. Yunoki, and T. Oshige. Elec Eng Jap, Vol 89, No 9, p 26-34, 1969. 9 p, 22

fig, 3 tab, 10 ref.

Descriptors: *Electrical insulators, *Contamination, Foreign research, Electrolytes, Electrodes, Electric arcs, Experimental data, Electrical coronas, Electric potential, Electrical equipment, *Electric insulation, Electric currents.

Identifiers: *Flashover, *Electric discharges,
*Suspension insulators, Air gaps, Waveforms, Japan.

Clarifying the flashover mechanism of the contaminated surface in connection with the insulation breakdown of an insulator is important. Discharge on a contaminated surface differs greatly from airgap discharge; the flashover voltage minimum does not occur in a contaminated surface discharge. Experimental studies of the impulse discharge on the electrolytic surface with the point and plate electrode are presented. Flashover voltage was invariant independently of the wave front duration of the impulse voltage. By using a photomultiplier placed along the discharge path, the partial discharge grows at a faster rate near the needle tip, slows down midway, and speeds up again near the plate. The flashoer voltage for the contaminated surface can be raised by placing the barrier electrode between the needle and plate. The barrier electrode blocks the passage of the partial discharge, resulting in an increase of the flashover voltage. Suspension insulators equipped with barrier electrodes exhibit excellent flashover characteristics. USBR) W70-09039

OPERATION AND MAINTENANCE OF LARGE HYDRO TURBINES - COLUMBIA AND SNAKE RIVERS.

Corps of Engineers, Walla Walla, Wash. Edward E. Ashley.

Amer Power Conf, 32nd Annu Meet, Chicago, Ill,

Apr 1970. 19 p, 12 fig, 1 tab, 6 ref.

Descriptors: *Maintenance, Kaplan turbines, Francis turbines, Columbia River, Costs, Failure (Mechanics), *Turbines, Bearings, Turbine run-(Mechanics), Turbine blades, *Hydroelectric plants, Turbine blades, *Hydraulic turbines, Lubrication, *Power opera-tion and maintenance, Corrosion, *Repairing, Bonneville Dam, Contamination, Cavitation, Overloads, *Operation and maintenance.

Identifiers: Wicket gates, Packings, Corps of Engineers, Snake River, McNary Dam, The Dallas Project, Chief Joseph Dam Proj, Wash.

Problems encountered during operation and maintenance of large hydro turbines at the Bonneville, The Dallas, McNary, and Chief Joseph Projects on the Columbia River and at the Ice Harbor Project on the Snake River are described. The problems included the turbine and associated equipment, and involved: (1) grease line failure to the wicket gate lower bearing; (2) failure of the wicket gate combination thrust and guide bearing; (3) replacement of head cover sump pumps; (4) maintenance of tur-bine runners; (5) turbine failure during rejection tests; (6) failure of blade sevomotor flange gasket; (7) trouble with wicket gate clearances; and (8) rerating generators and the effect on turbines. Each problem is discussed and methods used for solution are given. Turbine data are tabulated for all the lants. (USBR) W70-09047

RUSSIANS PUSH MAGNETOHYDRODYNAMIC

POWER, Thomas R. Brogan. Power, p70-71, May 1970, 1 fig, 1 tab.

Descriptors: *Generators, *Electric power, Conductivity, Electrodes.

dentifiers: *Magnetohydrodynamic power, Seed, nvester, Magnetic field.

are developing Russians netohydrodynamic power generating plant which will operate on natural gas and develop 75 MW, 25 MW of which will be produced by the generator and the remainder by a bottoming steam plant. In the generator plant, known as U-25, power is removed via 48 electrode pairs along the channel, and there are 48 investers which can be interconnected in a multitude of ways to provide operating flexibility. The main advantage of this method of power generation is its efficiency, some 15% above that of the conventional coal-fired stations. The apparent shortcomings of the Russian plant are its low-combustion pressure and field strength. (Green-Vanderbilt) W70-09167

A CONTRIBUTION TOWARDS THE REDUC-TION OF ICE FOG CAUSED BY HUMID STACK GASES AT ALASKAN POWER STA-

Glasgow Univ. (Scotland); and Dartmouth Coll.,

For primary bibliographic entry see Field 05G. W70-09172

SPACE HEATING IN URBAN ENVIRON-

Oak Ridge National Lab., Tenn.

A. J. Miller.

This study was sponsored by the U. S. Department of Housing and Urban Development under the contract between the Union Carbide Company and the U. S. Atomic Energy Commission. Oak Ridge National Laboratory TID Document No. CONF-680810, p 219-237, 1968. 13 fig, 7 tab, 19 ref.

Descriptors: *Nuclear powerplants, *Nuclear energy, *Thermal powerplants, *Heating, *Cooling, *Air conditioning, *Thermal power, *Nuclear reactors, *Multiple-purpose projects, *Powerplants, *Pollution abatement, *Water pollution control, *Water cooling, *Steam turbines, *Water conservation, *Thermal pollution, *Energy losses, *Electric reactors, *Underground powerplants, Water conservation, Water temperature, Steam, Urbanization, Turbines, Electricity, Air pollution, Natural resources, Cost comparisons, Heated water, Electric power industry. Identifiers: *Waste heat, *Energy centers, *Utilization of waste heat, *Central heating and cooling, *Space heating, Air pollution control, Power costs, Conservation of energy, Fossil fuel, Heating costs, Turbine bleed steam, Back-pressure steam.

Reports the preliminary findings of a systems analysis of the usefulness of nuclear energy centers in or near large cities and the application of energy centers to the development patterns and problems of American cities. It is concluded that in 1980 the heat from a nuclear energy center could be used to heat and air-condition a large portion of a large city at a cost per unit of heat equivalent to that now incurred by district heating in downtown commercial and high-rise apartment areas. The areas served could be much larger and they could consume much less heat per unit of area than those now served in this country by district-heating systems. Heat from back-pressure steam and turbine bleed would be used rather than heat from prime steam; therfore the waste of heat from the plant generating electricity would be significantly reduced. Such a system would reduce both chemical pollution of the air and thermal pollution of streams. Calculations indicate that distribution piping systems could be averaged to a system to the control of the be extended to serve larger areas economically, and that the use of medium or high temperature water would be more economical than high-preswater would be more economical than high-pressure steam. Investigations of system reliability, time variation in load, economics, geographical influences, and accuracy of calculations are recommended. (Poertner) W70-09192

USES OF WASTE HEAT, Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 03C.

HOLYOKE WATER POWER CO V AM WRITING PAPER CO (USE OF WATER POWER BEYOND SCOPE OF GRANT).

For primary bibliographic entry see Field 06E. W70-09475

8D. Soil Mechanics

FOUNDATION SETTLEMENT AND GROUND REACTION CALCULATIONS USING A DIGITAL COMPUTER,

Taylor Woodrow Construction Ltd. southall (En-

gland). K. F. Zbirohowski-Koscia, and D. A. Gunasekera Civ Eng Pub Works Rev, Vol 65, No763, p 152-157, Feb 1970. 5 p, 10 fig, 4 ref.

Descriptors: *Foundations, *Settlement (Structural), Stress, *Computer programs, Soil mechanics, Soils, Numerical analysis, Deformation, mechanics, Soils, Numerical analysis, Deformation, Stress distribution, Soil properties, Flexible foundations, Calculations, *Soil pressure, Rigid foundations, Footings, Load distribution.
Identifiers: *Computer-aided design, Computer applications, Boussinesq equation, Spread footings, Compressible foundation, Mat foundations.

Three computer programs for calculating settlements and ground reactions under foundations on nonhomogeneous ground are described. The programs are based on 2 simplifying assumptions: (1) ground stress is distributed in accordance with the Boussinesq formula, and (2) Young's modulus of the ground at each level veries lively resident. the ground at each level varies linearly between boreholes. The first program calculates settlement at several chosen points. The load causing the settlements is represented by a system of point loads. The second program calculates ground reactions and settlements under one or more rafts. This calculation proceeds in 2 stages for 2 extreme cases. In the first stage, ground reaction is assumed planar and independent of the rigidity of the raft. The optional second stage assumes that the raft is infinitely rigid compared to the ground. Ground reactions are progressively redistributed so that the ground deformation approaches a plane. The procedure is iterative and must be repeated until adequate precision is obtained. Average deformation, bending moments, and shearing forces are calculated for both cases. The third program repeats the operations of the second program but for rafts of finite rigidities. (USBR) W70-09036

A CRITICAL STUDY OF THE THEORIES CONCERNING UPLIFT IN HYDRAULIC STRUCTURES ON PERVIOUS FOUNDATIONS, College of Engineering, Madras (India).

V. C. Kulandaiswamy, and T. N. Ramaswamy.
13th Congr Int Assn Hydraul Res, Proc Vol 4, p
311-320, Aug-Sept 1969. 10 p, 5 fig, 10 ref.

Descriptors: *Uplift pressure, *Hydraulic structures, Dams, Pore water pressures, Theory, Hydrostatic pressure, Pore pressure, Seepage, Weirs, Foundations, Pervious soils, Soil mechanics, Percolation, Underseepage, Electric analogs. Identifiers: Hydraulic uplift, Comparative studies.

Development of various theories concerning uplift under hydraulic structures on pervious foundations is traced. Creep theory and potential theory are reviewed. Uplift pressures calculated for a few weir profiles using methods proposed by Bligh, Lane, Khosla, and Chugaev are compared to pressures obtained using the electrical analogy method. Relative merits of the methods are discussed. Khosla's and Chugaev's methods, based on potential theory, gave satisfactory results. Khosla's method is restricted to cases of very deep foundations; Chugaev's method reduces the problem to a few simple

equations and can be applied to foundations of limited and unlimited depths. Chugaev's method is particularly suitable for field application. (USBR)

LATERAL PRESSURES ON RIGID PER-MANENT STRUCTURES,

Mueser, Rutledge, Wentworth and Johnston, New York.

James P. Gould.

Amer Soc Civ Eng Spec Conf Lateral Stresses in Ground and Design Earth Retaining Struct, Cornell Univ, Ithaca, N Y, June 1970. 51 p, 16 fig, 1 tab, 39

Descriptors: *Lateral forces, *Earth pressure, Walls, Movement, Loads (Forces), Locks, *Retaining walls, Docks, Foundations, Anchors, Passive pressures, Horizontal loads, Slope stabilization. Anchored bulkheads, Soil mechanics, Active pressures, Structural analysis, Soil pressure, Strain, Deflection, Bibliographies, Overconsolidation. Identifiers: *Rigid structures, Slurry trenches, Design practices, At rest pressure, Swelling pressures. Soil-structure interaction.

Factors influencing lateral earth pressures on rigid retaining structures are reviewed, and analysis of walls of 5 categories of deep permanent structures are discussed. The 5 categories are: (1) cantilever retaining walls, (2) walls of U-frame locks and docks, (3) foundation walls of structures, (4) slurry trench concrete walls for foundation construction, and (5) rigid structures for slope stabilization. Each category is discussed from the standpoint of providing some information to assist designers in the difficult judgments necessary in analyzing walls subjected to lateral earth pressures. Specific conclusions are presented for each category. General conclusions are that as substructures become larger and more complicated, soil-structure interaction becomes more important than the esoteric properties that the soil may potentially possess; and with ordinary U S soil types lacking great sensitivity, lateral earth pressures can be rationalized from a knowledge of construction methods and structural characteristics, and no especially startling or unexpected loadings are likely. Has 39 references. USBR) W70-09045

LEAKAGE THROUGH BURIED CHANNELS, For primary bibliographic entry see Field 04A. W70-09049

RESEARCH INTO THREE-DIMENSIONAL SEEPAGE IN JOINTED ROCK FOUNDATIONS OF HIGH DAMS.

For primary bibliographic entry see Field 04A. W70-09050

RHEOLOGICAL AND ULTIMATE STRENGTH PROPERTIES OF COHESIVE SOILS,

Kentucky Dept. of Highways, Lexington. Div. of Research.

Research.
Gordon D. Scott.
Available from NTIS as PB-191 368, \$3.00 in paper copy, \$0.65 in microfiche. Kentucky Highway Dept. Interim Research Report KYHPR 65-38, HPR i (4), Part II, Feb 69. 96 p.

Descriptors: *Soil strength, Soil density, *Soil tests, Soil stability, *Roadbanks. Identifiers: Viscoelasticity.

Results of a laboratory study on strength properties of undisturbed and remolded soils is reported. The purpose of the study was to demonstrate that an accurate failure envelope could be developed by testing a single specimen. Thirty-one undisturbed samples were tested in unconfined compression, consolidation, triaxial, and stress relaxation. Eighty re-molded specimens (sixty were kaolin) were tested similarly and, in addition, were subjected to a special series of relaxation-triaxial tests. Stress relaxa-

Field 08—ENGINEERING WORKS

Group 8D—Soil Mechanics

tion was measured for one hour after straining the 4 in. long specimen 0.01-inch. Triaxial specimens were tested by applying an axial load at the rate of 2 percent per hour. (BPR) W70-09452

8E. Rock Mechanics and Geology

ON GEOLOGICAL AND TECHNOLOGICAL ASPECTS OF ORIENTED N-SIZE CORE DIAMOND DRILLING,

Newcastle Univ. (Australia); and Broken Hill Proprietary Co. Ltd., Shortland (Australia).

K. H. R. Moelle, and J. D. Young Eng Geol, Vol 4, No 1, p 65-72, Jan 1970. 8 p, 1

Descriptors: Drill holes, *Drilling, *Drilling equipment, Boreholes, Mining, *Core drilling, *Cores, Orientation, Petrofabrics, Coal mines, Mining engineering, Petrographic investigations, Engineering geology, Rock mechanics, Subsurface investigations, Geologic investigations.

Identifiers: *Diamond drilling, *Core recovery,

Australia, Foreign products, *Oriented cores.

A device has been developed to obtain oriented Nsize diamond drill cores from relatively deep slim holes. The device fits into a standard N-size vertical hole (3-in. dia) and may be operated using standard diamond drilling equipment. The equipment consists of a preset mechanical timer, compass unit with a paper chart recorder, diamond scribers for marking the core, and a core lifter. The procedure for obtaining oriented cores is described. Improvements in design have overcome the problem of straining the core, which has made some cores unfit for petrofabric analysis. Experiences using the device in Australian coal mining and applications to mining geology are discussed. (USBR) W70-09028

CROSSING THE SIERRA MADRE FAULT ZONE IN THE GLENDORA TUNNEL, SAN GABRIEL MOUNTAINS, CALIFORNIA, Southern California Metropolitan Water District, Los Angeles.

R. J. Proctor, C. Marshall Payne, and D. C. Kalin. Eng Geol, Vol 4, No 1, p 5-8, 57-63, Jan 1970. 13 p, 6 fig, 1 tab, 9 ref.

Descriptors: *Tunnels, *Engineering geology, Geologic investigations, *Faults (Geology), Subsurface investigations, Geologic mapping, Field investigations, Earthquakes, Exploration, Alinements, Landslides, Rock properties.
Identifiers: Glendora Tunnel, Calif, Geologic maps,

Geologic profiles.

An excellent opportunity to observe and study a major fault zone was provided in 1966 during construction of the 6.2-mi Glendora Tunnel in California. The Sierra Madre fault zone extends for 55 mi along the steep front of the San Gabriel Mountains. As mapped in the tunnel, the fault zone has an apparent thickness of 520 ft. Within the fault zone are oil-stained brecciated Puente shale, and slivers of Precambrian gneiss and Cretaceous granite that have been thrust at least 700 ft over quaternary terrace deposits. A puzzling situation was encountered in the east portal area where drill holes showed terrace gravels 370 ft beneath apparent basement rocks. This feature was attributed to a thrust fault. Geologic investigations proved that a longer tunnel route would cost several million dollars less to build because of poor rock conditions along a shorter route. Tunnel construction was not adversely affected by the fault materials encountered, but was affected by bentonite shale adjacent to the fault zone. (USBR) W70-09031

8F. Concrete

CONTROL AND REPAIR OF CRACKS IN CONCRETE DAMS,

Bureau of Reclamation, Denver, Colo.

B. P. Bellport.

Int. Comm. on Large Dams, 9th Congress (Paper) Q.39-R.12 Montreal, Can, p 199-217, June 1970. 19 p, 1 fig.

Descriptors: *Cracking, *Cracks, *Repairing, Concrete control, Mixes, Concrete mixes, *Concrete dams, Concrete placing, Control, Contraction joints, Construction joints, Expansion joints, Mass concrete, Curing, Precooling, *Temjoints, Mass concrete, Curing, Precoding, Temperature control, Shrinkage, Expansion, Grouting, Cement grouting, Heat of hydration, Chemical grouting, Concrete technology.

Identifiers: *Crack control, Control joints, *Con-

struction control, Cooling systems, change, Cement hydration, Epoxy mortar.

Causes of cracking in concrete dams, control methods used by the Bureau of Reclamation to control and minimize cracking, and measures used to repair cracks are discussed. Most cracking in mass concrete occurs because of stresses caused by restraint against volumetric changes including temperature change, drying shrinkage, and autogenous shrinkage. Primary control methods are mix design, temperature control, and use of contraction, expansion, and construction joints. Because of the heat generated by hydration of the cement, the concrete mix selected one should provide the required strength and durability with the lowest cement content. Expansion and contraction joints are used to accommodate volumetric changes. Construction joints are used to facilitate construction and to reduce cracking tendencies. Temperature control measures used are precooling concrete ingredients, postcooling by means of embedded pipe systems, and restricting the time or season of concrete placement. Pressure injection of portland cement grout is the most economical method of repairing cracks. Epoxy grouts stop leaks and can restore the structural strength of concrete, but cracks must be dry for effective bonding. Chemical grouts have been used to seal small cracks. (USBR) W70-09019

A REVIEW OF STRESS-STRAIN RELATION-SHIPS FOR CONCRETE.

Northern Arizona Univ., Flagstaff. Sandor Popovics.

J Amer Concr Inst, Proc Vol 67, No 3, p 243-248, Mar 1970. 6 p, 2 fig, 2 tab, 35 ref, append

Descriptors: *Concretes, *Concrete technology, Concrete testing, Axial loads, Axial stress, Com-pressive strength, *Deformation, Strain, Stress, Flexural strength, Elasticity modulus, Reviews, Bibliographies, *Stress-strain curves, Reinforced concrete, Strength of materials, Cracking. Identifiers: *Concrete properties, Compressive stress, Formulas, Crack propagation.

A state-of-the-art survey is presented to provide an organized summary, analysis, and evaluation of knowledge on the instantaneous axial deformation of concrete under load. The shape of the stressstrain curve and the numerical approximation of the stress-strain diagram are discussed. The instantaneous deformation of concrete under load is influenced by testing conditions and composition of the concrete. The deformation mechanism is explained qualitatively by the theory of internal crack propagation; under short-time loading, the stressstrain curve deviates from the straight line mainly because of progressive internal cracking. The theory of internal cracking can only provide a qualitative description, and empirical formulas are used for numerical approximations. The limits of validity and degree of approximation for empirical formulas are given. Empirical formulas are also available for estimating unit strain and secant

modulus of elasticity at the ultimate compressive strength. Has 35 references. (USBR) W70-09032

CONSERVATION OF CRAFT SKILLS IN

Bureau of Reclamation, Denver, Colo.

C. F. Palmetier.

Annu Meet Amer Concr Inst, Chicago, Ili, Mar-r-Apr 1969. 12 p, 4 fig.

Descriptors: Construction, *Crafts, Concretes, *Labor, *Construction costs, Concrete placing,; *Concrete construction, Concrete mixes, Steel, *Designers, Concrete plants, Formwork (Construction), Reinforcing steel, Costs, Cleaning, Optimum use, Optimization, *Structural design, Systems analysis, Architecture, *Architects. Identifiers: *Building design, Design improvements, Spacing, Ready-mix concrete, Form 1 removal, Systems engineering.

For several years the construction industry has experienced change in basic concepts. This change is the substitution of machine power for human power whenever possible. The principal reason for the change is that today's highly skilled workmen are used most economically when their skills and not their muscles are exploited. While the use of available skills is basically the construction contractor's problem, the design engineer has the responsibility to give the contractor the opportunity for optimum use of the skills and power of his craftsmen. For example, with construction contractors proposing unit prices for concrete of \$200 and more, the designer must recognize that the cheapest components of structural concrete are cement and aggregate. Costs arise from wasteful use of highly skilled workmen in fabricating and setting intricate forms and unnecessary requirements for placing concrete in confined and congested forms. Perhaps the highly publicized systems approach to design should be expanded or complemented by a designer's systems approach to the efficient use of on-site labor. (USBR) W70-09033

DETAILING BY COMPUTER,

Zinn (W.V.) and Association (Great Britain). W. V. Zinn, and L. Rosten. Civ Eng Pub Works Rev, Vol 65, No 763, p 142-145, Feb 1970. 4 p, 6 fig, 2 ref, 2 append.

Descriptors: *Continuous beams, *Concrete structures, Plates, Computer programs, Beams (Structural), Reinforced concrete, Computers, Structural design, *Reinforcing steel, *Structural members, Calculations, Design tools, Slabs.

Identifiers: *Computer-aided design, *Design practices, Computer applications, Concrete slabs

A method using a computer to design and detail reinforced concrete continuous beams, plates, and slabs is described. The output is in tabular form to be used directly on site in conjunction with standardized fixing diagrams. The system has been designed to limit office drawing effort to the production of outlines of the structural concrete and to allocate to the computer the task of providing a full set of calculations and detailing instructions that will replace traditional reinforcement detail drawings. This system and further developments will form eventually the basis of a universal detailing process in which the productivity of the office drawing staff and site labor will be increased greatly. The work described is in the pioneer stage, but sufficient experience has been gained to show that the system is practicable and will become more valuable when a greater degree of rationalization is developed in architectural planning. (USBR) W70-09035

8G. Materials

FLY ASH UTILIZATION CLIMBING STEADI-

Environ Sci Technol, Vol 4, No 3, p 187-189, Mar 1970. 3 p, 3 fig.

Descriptors: *Fly ash, Coals, Thermal powerplants, *Byproducts, *Solid wastes, Lightweight aggregates, Pozzolans, *Waste disposal, Research and development, Cements, Bricks, Concrete technology, Concretes, Masonry.
Identifiers: Concrete blocks, Pollution control,

Most pollution control programs eventually evolve into an ultimate disposal program—getting rid of waste material having little or no economic value. For the electric utility industry, the ultimate disposal problem involves mountains of ash residue that accumulate at coal burning power stations. Fortunately, 17% of the fly ash is recovered for byproduct reuse, and the rate of utilization is rising. Present uses include: pozzolan in concrete, raw material for sintered lightweight aggregate, filler for asphalt, soil stabilization, and hydrated lime-fly ash compounds as base courses for roads. Promising new applications are raw material for cement manufacture, and manufacture of face brick. Fly ash brick is fully competitive with conventional clay brick is strength, performance, appearance, and price, and is 15% lighter. A fly ash processing plant is being built at Hamilton, Ontario, to process the entire 450-tpd fly ash output from Ontario Hydro's Lakeview coal burning power station. The processing plant will produce a uniform, graded product of consistent specifications. About 60% of the ash will be used for sintered aggregate, 15% will be used for pozzolan, and the remainder will be an iron-rich concentrate for steel and other industrial uses. (USBR)

8H. Rapid Excavation

COMPLEX EQUIPMENT FOR SINKING AND DRILLING OF VERTICAL SHAFTS, National Science Foundation, Washington, D.C.

Special Foreign Currency Science Information Pro-

gram. N. A. Malevich.

Available from NTIS as TT-68-50609, \$3.00 in paper copy, \$0.65 in microfiche. Trans. of Kompleksy Oborvdovaniya Dlya Prokhodki i Bureniya Vertikal'nikh Stvolov. Clearinghouse Translation TT68-50609, 1969. 383 p. NSF-C466.

Descriptors: *Core drilling, *Drilling equipment,

*Shafts (Excavation).
Identifiers: Vertical shafts, Shaft boring.

The designs, bases underlying the theory and calcaulation, results of experimental studies of Soviet and foreign complex assemblies of equipment and machines meant for sinking and boring shafts have been examined in the book. The book also discusses the technological schemes and technoeconomic indices of mechanized sinking of shafts, generalizes the experience gained by application and results of field trials of complex assemblies of sinking and boring equipment, indicates the future course of development of complex mechanization of work on installation of vertical shafts. W70-09447

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

RESEARCH ON WATER QUALITY, California Univ., Davis. Ray Coppock.

California University Water Resources Center Report No 19, July 1970. 36 p.

Descriptors: *Water quality, *Research facilities, *Projects, *Universities, *California, Education, Laboratories, Model studies, Water Resources Research Act

Identifiers: University of California.

A brief summary is given, as of mid-1970, of University of California research involving water quality. Preliminary or final results, or at least progress reports, are available for all UC research projects on water quality that have continued for more than a few months. They may be found in technical or semi-technical journals, in University publications, in reports of research units such as the Water Resources Center and the Sanitary Engineering Research Laboratory, or in reports to funding agencies. Scientific projects are described under five headings: measuring and monitoring water quality; biostimulation and other ecological aspects; water quality control and management; sewage and wastewater treatment; and drainage and groundwater quality. (Knapp-USGS) W70-09348

NATIONAL INSTITUTE OF ECOLOGY: AN INQUIRY, VOLUMES 1 AND 2. Ecological Society of America, Durham, N.C., and

Peat, Marwick, Mitchell and Co.

For primary bibliographic entry see Field 06F.

CHAPTER 3: EDUCATION AND THE EN-VIRONMENT.

National Academy of Sciences-National Academy of Engineering, Washington, D.C. Environmental Studies Board.

In: Institutions for Effective Management of the Environment, Washington, D.C. National Academy of Sciences - National Academy of Engineering, January 1970, p 29-36.

Descriptors: *Environment, *Education, Social needs, Universities, Colleges, Management, Planning.

*Environmental Mul-Identifiers: tidisciplinary programs, Public information.

Successful efforts to conserve our national resources and manage the environment more effectively will depend in large measure on our ability to train people to understand and to cope with the related complex technical and social problems, as well as to develop and implement programs for the distribution of information on a broad scale. Several suggestions are forwarded. First, it recommended that the National Science Foundation undertake to develop and sponsor a Junior Environmental Education Program at secondary school level designed to involve teenage youngsters with the whole range of environmental problems. Second, to facilitate environmental science in the oecond, to facinitate environmental science in the universities, two approaches are suggested: (1) Creation of multidisciplinary programs of environmental affairs within existing universities, to be funded in part by federal grants; and (2) Establishment of an experimental graphs are supported gradues. ment of an experimental problem-oriented graduate school to be supported in part by a proposed Environmental Coalition. Third, methods are suggested which can aid in the general education of the public. Finally, the establishment of an En-vironmental Coalition is suggested. This organiza-tion would coordinate and achieve support for all relevant publicly instigated programs and activities. (See also W70-08929) (Davis-Chicago) W70-09441

9C. Research Facilities

RESOURCES RESEARCH, JULY 1, 1968 - JUNE 30, 1969.
Geological Survey, Washington, D.C. Water Resources Div.

U S Geological Survey 7th Annual Report on Water Resources Research, January 1970. 387 p, 16 fig.

Descriptors: *Projects, *Water resources develop-ment, Research and development, Research facilities, International Hydrological Decade, Federal government, Tracers, Hydrology, Tracking techniques, Streamflow, Groundwater movement, Hydrology, William Branch, Branch B Estuaries, Water quality, Hydrologic cycle, Planning, Water management (Applied), Data collections

Identifiers: *U S Geological Survey, *Water resources research.

This, the seventh annual report on water resources research conducted by the Water Division, U. S. Geological Survey, presents information on the status of the 'core' research program of the Division. Much of the program is basic research aimed at developing an understanding of the workings of particular parts of the hydrologic cycle. Another large part of the activity is in water quality management and protection, in which much of the research deals with movement of radioactive material in the water cycle. The third important field is in new methods of collecting, analyzing, and interpreting hydrologic data. Some project activities are associated with the International Hydrological Decade program (IHD). This report is intended primarily for use by the Geological Survey and is distributed only to members of the Survey staff, advisory committees, and others with special interest in development of water resources research. (Lang-USGS)

9D. Grants, Contracts, and **Research Act Allotments**

RESEARCH ON WATER QUALITY,

California Univ., Davis. For primary bibliographic entry see Field 09A. W70-09348

RESEARCH, JULY 1, 1968 - JUNE 30, 1969.
Geological Survey, Washington, D.C. Water
Resources Div. WATER For primary bibliographic entry see Field 09C. W70-09389

10. SCIENTIFIC AND TECHNICAL INFORMATION

PROFILING **SUBBOTTOM** ACOUSTIC SYSTEMS, A STATE-OF-THE-ART SURVEY, Army Engineer Waterways Experiment Station, For primary bibliographic entry see Field 02A. W70-09176

FLOOD DAMAGE PREVENTION. Tennessee Valley Authority, Knoxville.

Tennessee Valley Authority Indexed Bibliography, 6th Edition, July 1969. 43 p, 1 fig, 407 ref, index.

Descriptors: *Bibliographies, *Flood protection, *Non-structural alternatives, *Flood plain zoning, Flood plain insurance, Flood control, Warning systems, Water law, Regulation, Legislation, Zon-

Identifiers: Flood damage prevention (Bibliog-

A bibliography and index are presented of recent literature on both structural and nonstructural methods of flood damage prevention and control. The majority of the entries emphasize flood damage prevention and control. damage prevention and flood plain regulation, with only a few items on flood control. Most of the publications cited are available on inter-library loan from the TVA Technical Library, Knoxville, Tenn. (Knapp-USGS)

Field 10—SCIENTIFIC AND TECHNICAL INFORMATION

W70-09364

HYDROLOGICAL BIBLIOGRAPHY.

Bulletin International Association of Scientific

Hydrology, Vol 15, No 2, p 121-134, June 1970. 14 p.

Descriptors: *Bibliographies, *Hydrology, *Water resources, International Hydrological Decade.

A short bibliography of general hydrological papers categorized by country or international organization and published in 1969-1970, is presented. I Some of the books and longer papers are reviewed. I (Knapp-USGS)
W70-09376

SUBJECT INDEX

ADMINISTRATIVE AGENCIES

BAY ISLAND DRAINAGE AND LEVEE DIST NO 1 V NUSSBAUM
(OPERATION COSTS OF PUMPING FACILITY).

W70-09155

06C AESORPTION ABSCRPTION AND INFILTRATION IN TWO- AND THREE-DIMENSIONAL MIAMI BEACH JOCKEY CLUB, INC V DERN (GOVERNMENT CONTROL OVER OBSTRUCTIONS TO NAVIGATION). W70-09478 ABSTRACTS
DISTILLATION DIGEST VOLUMES 1 AND 2.
W70-09360 03A ADMINISTRATIVE DECISIONS
COMM'ES OF DRAINAGE DISTRICT NO 5 V ARNOLD (JUDICIAL
INTERFRETATION OF DRAINAGE STATUTE).

04A ACCELERATED EROSION
YEARSLEY W W A ROSS CONST CO (LIABILITY OF PRIVATE CORPORATION ACTING PURSUANT TO AN ACT OF CONGRESS).
06E MEYERING LAND CO V SPENCER (DRAINAGE EISTRICT HAS NO POWER TO CONSTRUCT SEWERS UNDER AUTHORITY FOR DRAIN CONSTRUCTION). W70-09488 ACCESS ROUTES
COOPER V CITY OF BOGALUSA (FEDERAL RESPONSIBILITY FOR DAMAGES CAUSED BY NAVIGATION IMPROVEMENTS). EXPERIMENTS ON THE ADSORPTION OF AMMONIUM IONS BY CLAY PARTICLES IN NATURAL WATERS, U70-09211 02K ACCITMATIZATION

FFECT OF TEMPERATURE SHOCK ON THE TEMPERATURE RESISTANCE OF
FOUNLICHTERN AQUATIC ANIMALS. EXPERIMENTS ON THE PROBLEM OF
EFAT AND COLD-HARDENING IN ANIMALS (GERMAN),
W70-09436 MOISTURE CONTENT AND HYDROPHILITY AS RELATED TO THE WATER CAPILLARY RISE IN SOILS, W70-09296 ACCRETION (LEGAL ASPECTS)
DICKSON V SANDEFUR (DISPUTED CWNERSHIP OF LAND APPEARING
AFTER SUDDEN SHIFT IN BIVER'S COURSE).
#70-09060
06E AERATED LAGOONS
AERATED LAGOONS TREAT SECONDARY EFFLUENT,
W70-09331
05D ICHEON EXTENSION MINING CO V FLLIS (OWNERSHIP OF ACCRETED IANDS). W70-09465 REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBICSIS, W70-03187 ACCUSTIC EROFILING SYSTEMS
ACOUSTIC SUBBOTTOM PROPILING SYSTEMS, A STATE-OF-THE-ART SURVEY,
W70-09176
02A BOD AND COLOR REMOVAL FROM KRAFT MILL WASTES, AERATED LAGOONS TREAT SECONDARY EFFLUENT, W70-09331 05D ACTIVATED CAREON COOR CONTROL METHODS, EXPERIMENTATION AND APPLICATION, W70-09190 05D COMPARISON OF AERATION EFFICIENCY UNDER PROCESS CONDITIONS, $\ensuremath{\text{W}70-69510}$ TREATMENT AND SLUDGE DISPOSAL OF WASTES FROM THE MANUFACTURE OF ACTIVATED CARBON, W70-09339 AEROBIC TREATMENT
A STIDY OF FARE WASTE, FARM ANIMAL WASTE CHARACTERIZATION,
HANDLING, UTILIZATION,
W70-09426
05B ACTIVATED SLUDGE
REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBIOSIS,
W70-09187 05D AESTHETICS
ELECTRIC POWER - IMPACT ON THE ENVIRONMENT, W70-09020 06B ODOR CONTROL METHODS, EXPERIMENTATION AND APPLICATION, W70-09190 AESTIVATION
HEART RATE AND CHANGES IN BODY FLUIDS IN AESTIVATING TOADS
FROM XEEIC HABITATS,
W70-09148
021 CATTLE SKIN TANNERY WASTES TREATMENT IN A COMPLETELY MIXED ACTIVATED SLUDGE PILOT PLANT, 05D AGRICULTURE
DIGESTED SLUDGE DISPOSAL ON CROP LAND,
W70-09328
05D AFRATED LAGCONS TREAT SECONDARY EFFLUENT, W70-09331 RESPONSE OF DAIRY WASTE ACTIVATED SLUDGE TO EXPERIMENTAL CONDITIONS AFFECTING PH AND DISSOLVED OXYGEN CONCENTRATION, W70-09332 AIR ADMISSION
FLOW OF ENTRAINED AIR IN CENTRIFUGAL FUMPS,
W70-09023
08c CONTROL MECHANISMS OPERATIVE IN A NATURAL MICROBYAL FOPULATION SELECTED FOR ITS ABILITY TO DEGRADE 1-LYSINE, II. EFFECTS OF FRUCTOSE AND RIBOSE IN BATCH SYSTEMS, W70-09336 AIR CONDITIONING
SPACE HEATING IN URBAN ENVIRONMENTS,
W70-09192 AUTOMATED ACTIVATED SLUDGE PLANTS WITH RESPIRATORY NETAECLISM CONTROL, W70-09502 USES OF WASTE HEAT, W70-09193 AIR ENTHAINMENT
FLOW OF ENTRAINED AIR IN CENTRIFUGAL FUMPS,
W70-09023
08C ENERGY AND HYDRAULIC TESTS ON MECHANICAL APPATION SYSTEMS, W70-09503 FIUCTUATION OF EFFLUENT QUALITY IN ACTIVATED SLUDGE PLANTS, \$70-09504 AIR FLCTATION
FLEXIBILITY KEY TO DESIGN OF MACHINING PLANT'S TREATMENT
FACILITIES,
W70-09326
05D THICKENING CHARACTERISTICS OF ACTIVATED SLUDGE, W70-09505 AIR POLIUTION
CHEMICAL COMPOSITION OF PRECIPITATION IN REGIONS OF THE
SOVIET UNION,
W70-09123
02B KINETIC ASPECTS OF THE TREATHENT OF PHENOLIC WASTES, 870 - 09506INVESTIGATION ON THE CONTROL OF FILAMENTOUS BULKING, W70-09509 TURBULENT DIFFUSION IN A STABLY STRATIFIED SHEAR LAYER, COMPARISON OF AFRATION EFFICIENCY UNDER PROCESS CONDITIONS, W70-09510 LEAD IN A SUBURBAN ENVIRONMENT, W70-09251 ACTIVATED SLUIGE PROCESS

EFFECTIVE PROSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE
ACTIVATED SLUDGE PROCESS,

W70-09186 AIR POLIUTION EFFECTS
ODOR CONTROL METHODS, EXPERIMENTATION AND APPLICATION, W70-09190 AIR TEMPERATURE
A STUDY OF HEAT TRANSFER COEFFICIENTS IN THE LOWEST 400
METERS OF THE ATHOSPHERE,
02B ADAPTATION

EPPECT OF TEMPERATURE SHOCK ON THE TEMPERATURE RESISTANCE OF
FOIKTLOTHERM AQUATIC ANIMALS. EXPRIMENTS ON THE PROBLEM OF
HEAT AND COLD-HARDENING IN ANIMALS (GERMAN),
W70-09436 A SELECTED ANNOTATED BIBLIOGRAPHY OF ENVIRONMENTAL STUDIES OF POLAND, 970-09456 ADMINISTRATION
SOIL, WATER AND SUBURBIA.
W70-09168

ALASKA

ALA-ACU SUBJECT INDEX

RECONNAISSANCE OF WATER RESOURCES IN THE HAINES-PORT CHILKOCT AREA, ALASKA, AMMONIA TOXICITY IN SELECTED FISHES, W70-09430 UNITED STATES V ALASKA (RELATIVE RIGHTS IN SUBMERGED LAND). W70-09242 $06E$ AMMONIA TOXICITY
AMMONIA TOXICITY IN SELECTED FISHES,
w70-09430 EFRGER V OHISON (NO ABSOLUTE RIGHT TO TOLL FREE USE OF GOVERNMENT CONTROLLED DOCK). AMMONIUM ACETATE
AMMONIA TOXICITY IN SELECTED FISHES,
W70-09430 #70-09469 ALBERTA (CANADA)
BIGRATION OF SOLUBLE SALTS IN AN IRRIGATED FIELD IN RELATION TO RAINFALL AND IRRIGATION, W70-C9140 03C ANAEROPIC BACTERIA
REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBIOSIS,
W70-09187 05D ALCOROL EICDEGRADATION OXIDATION OF ALCOHOLS AND THEIR INFLUENCE ON THE SELF-EURIFICATION OF NATURAL WATERS, ANAEROEIC CONDITIONS
REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBIOSIS,
W70-09187
05D ANAEROBIC DIGESTION REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBIOSIS, W70-09187 05D ALCOHOLS OXIDATION OF ALCOHOLS AND THEIR INFLUENCE ON THE SELF-FORIFICATION OF NATURAL WATERS, A STUDY OF FARM WASTE, FARM ANIMAL WASTE HARCLING, UTILIZATION, W70-09426 05B CHARACTERIZATION, ANTONIC AND NONIONIC SURFACTANT SORPTION AND DEGRADATION BY ALGAE CULTUBES, ANAFROEIC TREATMENT REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBIOSIS, 970-09187 05D M70-09438 ALGAE BLOCKS WATER QUALITY IN RELATION TO PRODUCTIVITY OF LAKE ASHTABULA ESSENVOIR IN SOUTHEASTERN NORTH DAKOTA, 7070-9099, 50 TREATMENT OF DAIRY MANURE BY LAGOONING, 05D AIGAL CANCER AND CAUSAL SUBSTANCES IN WASTES FROM THE COAL CREMICAL INDUSTRY, W70-09437 ANAEROBICSIS REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBICSIS, W70-09187 05D ELECTROLYTIC MODEL STUDY FOR COLLECTOR WELLS UNDER RIVER ALGAL CONTROL EFFECTIVE PHOSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE ACTIVATED SIUDGE PROCESS, 95D BEDS. W70-09210 AQUIFER SIMULATION ON SLOW TIME RESISTANCE-CAPACITANCE ALRALINE SOILS
BIGRATION OF SOLUBLE SALTS IN AN IRRIGATED FIELD IN RELATION
TO FAINFALL AND IRRIGATION,
W70-09140
03C ANIMAL WASTES
A STUDY OF PARM WASTE, FARM ANIMAL WASTE CHARACTERIZATION,
HANDLING, UTILIZATION,
W70-09426
05B ALKIL FHENCL FOLYETHOXYLATE
ANIONIC AND NONIONIC SURFACTANT SORPTION AND DEGRADATION BY
ALGAE CULTURES,
#70-09438
05c SOME NUMERICAL METHODS FOR SOLVING PROBLEMS OF NOR-STEADY SEPPACE IN NON-HOMOGENEOUS ANISOTROPIC SOILS, W70-09309 ALKYL FOLY ETHOXYLATE
ANIONIC AND NONIONIC SURFACTANT SORPTION AND DEGRADATION BY
ALGAE COLTURES, INTERNAL CATHODIC PROTECTION OF WATER COOLED PLANT, W70-09014 08C ALLUVIAL CHANNELS COMMON ERRORS IN DEVELOPING A GROUNDWATER AQUIFER, W70-09225 02F ANTARCTIC
CHEMICAL HYDROLOGY OF REGIONS OF EAST ANTARCTICA,
W70-09134
02K EFFECTS OF FFFLUENT AND IMPLUENT SEEPAGE ON THE HYDRODYNAMIC FORCES ACTING ON AN IDEALIZED NONCOHESIVE SEDIMENT PARTICLE, W70-09410 ANURANS
THE TEBRESTRIAL ECOLOGY OF THE SPADEFOOT TOAD SCAFHIOPUS
HAMMONDII,
W70-09146
02G RECONVAISSANCE OF THE GROUNDWATER RESOURCES OF THE MISSOURI BIVER ALLUVIUM BETWEEN HIAMI AND KANSAS CITY, MISSOURI, B70-09249 02F APPORTIONMENT
NEBRASKA V WYOHING (APPORTIONMENT OF INTERSTATE WATERS UNDER PRIOF APPROPRIATION).
870-09461
06E ESTIMATING STORAGE CAPACITY IN DEEP ALLUVIUM BY GRAVITY-SEISHIC HETBODS, H70-09373 APPROPRIATION
ARIZONA V CALIFORNIA (RELATIVE RIGHTS IN COLORADO RIVER ALI-VACUUM CHLORINATION SYSTEM
ADVANCES IN HANDLING GAS CHLOFINE,
W70-09319 WATER) . W70-09066 05D ALTERATION OF FLCW
KUHN V CHESAPPAKE AND O RY (EFFECT OF CHANGE OF NATURAL
BATERCOURSE CN FEOFERTY BOUNDARIES).
H70-09076
O6E UNITED STATES Ψ WALKER RIVER IRRIGATION DIST (RIGHT TO USE OF STREAM BASED ON PRIOR APPROPRIATION). $\Psi 70-09174$ 06E ICKES V FOX (PROTECTION OF PRIVATE APPROPRIATION RIGHTS IN A PEDERAL RECLAMATION PROJECT). FRANKLIN V UNITED STATES (CONSEQUENTIAL DAMAGE FROM FEDERAL DIRE CONSTRUCTION IN IMPROVEMENT OF NAVIGATION). W70-09080 $_{\rm OGE}$ AQUATIC ANIMALS
A STUDY OF THE AQUATIC ECOSYSTEMS IN THO NATIONAL WATERFORD
REFOGES IN MISSISSIPPI,
W70-09346
021 TALY V STATE (FLOOD DAMAGES CAUSED BY CANAL CONSTRUCTION). 0.04 A AQUATIC ENVIRONMENT A STUDY OF THE AQUATIC ECOSYSTEMS IN TWO NATIONAL WATERPOWL REFUGES IN MISSISSIPPI, W70-09346 ALUB EFFECTIVE PROSFHORUS REMOVAL BY THE ADDITION OF ALUM TO THE ACTIVATED SLUGE PROCESS, USD OSD AQUIFER CHARACTERISTICS
A STUDY OF THE HYDROCHEMICAL PACIES OF THE WILCOX AQUIPERS IN HISSISSIPPI, W70-09095 FHOSPHORUS REMOVAL WITH FERRIC IRON AND ALUMINUM, W70-09507 AQUIFERS
A NUMERICAL TECHNIQUE FOR CALCULATING THE TRANSIENT POSITION
OF THE SALTWATER FRONT,
W70-09196 ALUMINUM SOLFATE

EFFECTIVE PROSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE

ACTIVATED SIDDGE PROCESS,

#70-09186

05D

DIGITAL ANALYSIS OF AREAL FLOW IN MULTIAQUIFER GROUNDWATER

SYSTEMS A QUASI THREE-DIMENSIONAL MODEL, W70-09197

WATER-LEVEL AND WATER-QUALITY TRENDS IN AQUIFERS ALONG THE MISSISSIFFI GUIF COAST, 1970, W70-09223 02F

EUMPING TESTS AND HYDROGEOLOGICAL INVESTIGATIONS OF AN ARTESTAN AQUIFER NEAR HORSENS, DENMARK, 02F

CN THE SCLUTION OF INVERSE PROBLEMS IN HYDROGEOLOGY (FRENCH), W70-09371 02F

ESTIMATING STORAGE CAPACITY IN DEEP ALLUVIUM BY GRAVITY-SEISHIC METHODS, N70-09373

ELECTROMAGNETIC AERIAL SURVEY OF A FRESH WATER-SALT WATER COMTACT IN THE RHONE DELTA (FRENCH), 07B

THE USE OF SEISMIC REFRACTION AND GRAVITY METHODS IN HYDROGECICGICAL INVESTIGATIONS, 678

EGREBOLE GEOPHYSICS AS APPLIED TO GROUNDWATER, W70-09400 0.78

A REVIEW OF SOME PROBLEMS OF SEISMIC PROSPECTING FOR GROUNTWATER IN SURFICIAL DEPOSITS, W70-09402 07B

INTERPRETATION OF GEOELECTRICAL RESISTIVITY MEASUREMENTS FOF SOLVING HYDROGEOLOGICAL EROBLEMS, 078

ARCTIC CLIMATIC OSCILLATIONS 1200-2000 A D.

CHARACTERISTICS OF PERMAPROST AND OF THE ACTIVE LAYER IN WEST SILERIA, W70-09257

CHEMICAL CHARACTERISTICS OF WATER MASSES IN THE AMERASIAN BASIN OF THE ARCTIC OCEAN, W70-09230

ABIC LANDS
A PREDICTION EQUATION FOR VEGETATION EPPECTS ON WATER YIELD
FROM WATERSHEDS IN ABID AREAS,
W70-09361
03B

ARIZONA ARIZONA V CALIFORNIA (RELATIVE RIGHTS IN COLORADO RIVER BATER). 06E

WERDE RIVER IRRIGATION AND POWER DIST W SALT RIVER WALLEY WATER USERS' ASS'S (COMTRACTUAL RIGHTS TO DAMSITE). W70-09083

ARKANSAS
UNITED STATES V SPONENBARGER (ALLEGED TAKING OF PRIVATE
FROFERTY WITHOUT JUST COMFENSATION VIA PLOOL CONTROL PLAN).
W70-09068
06E

MCALLISTER V SLOAM (FLOODING OF PROPERTY DUE TO DAM CONSTRUCTION).

ANDERSON V HOBBS TIE AND TIMBER CO (TITLE TO BRIDGE RESTING UPON FIVES EEC). Q6E

ASSESSMENTS
CROSBY W DE LAND SPECIAL DRAINAGE DIST (VALUE TO FARMLAND OF IMPECVEL DRAINAGE SYSTEM).
04A
470-09051

WARNEY RIVER DRAINAGE DIST V SPIEDEL (ASSESSMENTS ON LAND HELD BY EQUITABLE TITLE). 06E

ATIANTA (GECEGIA) FIOOD PLAIN INFORMATION, METROPOLITAN ATIANTA GEORGIA, UTOY CREEK, NOETH AND SOUTH UTOY CREEKS-

NANTIC OCEAN
WISUAL CBSEEVATIONS OF SUSPENDED-PARTICLE DISTRIBUTION AT
THREE SITES IN THE CARIBEEAN SEA,
W70-09231

AUTOMATED ACTIVATED SLUDGE PLANTS WITH RESPIRATORY METABOLISM CONTROL, U70-09502

DICKSON V SANDEFUR (DISPUTED OWNERSHIP OF LAND APPEARING LETTER SUEDEN SHIFT IN RIVER'S COURSE).

06E

ACKWATER
UNITED STATES V DICKINSON (EMINENT DOMAIN BY RAISING LEVEL
CF FIVER PUBSUANT TO CONSTRUCTION OF DAM).
06E
070-09074

CONTINENTAL LAND CO V UNITED STATES (CONDEMNATION VALUE OF LANDS TO RE FLOODED BY A DAN). W70-09477 06E

BACTERIAL REMOVAL MICROBIOLOGY OF A WASTE STABILIZATION POND, W70-09508 05D

BAFFLES BAFFLED BIOLOGICAL BASIS FOR TREATING POULTRY PLANT WASTES, W70-09320 05D

BAYS
SOME EFFECTS OF FRESH-WATER INFLOW ON THE FLUSHING CF SOUTH
SAN FRANCISCO BAY A PRELIMINABLY BEFORT,
W70-09215
056

HOVEMENT OF SEABED DRIFTERS IN THE SAN FRANCISCO BAY ESTUARY AND THE ADJACENT PACIFIC OCEAN A PRELIMINARY REPORT, 970-09216 O2L

A SUMMARY OF PRELIMINARY STUDIES OF SEDIMENTATION AND HYDROLOGY IN BOLINAS LAGOON, MARIN COUNTY, CALIFORNIA, W70-09235 02L

AVIAS
TEMPERATURE-DEPENDENT CHARACTERISTICS OF PERIPHERAL NERVES
EXPOSED TO DIFFERENT THERMAL CONDITIONS IN THE SAME ANIMAL,
#70-09160 05C

THE EFFECT OF BED-LOAD MOVEMENT ON THE VELOCITY DISTRIBUTION OF FLOW, W70-09052

BEDLOAC MOVEMENT TRACER STUDIES ON THE MOVEMENT OF SAND AND GRAVEL,

THE EFFECT OF BED-LOAD MOVEMENT ON THE VELOCITY DISTRIBUTION OF FICW, W70-09052

BEDS UNDER WATER UNITED STATES V ALASKA (RELATIVE RIGHTS IN SUBMERGED LAND) -W70-09242 06E

IN RE CITY OF NEW YORK (RIGHTS OF OWNERS OF BEDS SUBSERVIENT TO UFLAND OWNER'S RIPARIAN RIGHTS).

W70-09457
06E

BENZANTHRONE
ALGAL CANCER AND CAUSAL SUBSTANCES IN WASTES FROM THE COAL
CHEMICAL INDUSTRY,
W70-09437

BIBLIOGRAPHIES
FLOOD DAMAGE PREVENTION.
W70-09364 10

HYDROLOGICAL BIBLIOGRAPHY. W70-09376

BIOASSAY

EFFECT OF TEMPERATURE AND SALINITY ON THE HEAT TOLERANCE IN
THE HERNIT CRAB, DIOGENES BICRISTIMANUS,
W70-09166

05C

AN ANALYTICAL METHOD FOR EVALUATING THE SUSCEPTIBILITY OF FISH SPECIES TO AN AGRICULTURAL CHEMICAL (JAPANESE), 2720-2013 W70-09433

PRELIMINARY RESULTS OF THE EXPERIMENTS ON THE TOXICITY OF OIL COUNTERACTING AGENT (ESSO COREXIT 7664), WITH AND WITHOUT IRAQ CRUDE OIL, FOR SELECTED HEMBERS OF MARINE

TOXICITY OF SELECTED HERBICIDES TO BLUEGILL SUNFISH, W70-09435

BIOCHEMICAL OXYGEN DEMAND
ANALYSIS OF LAG PHASE BOD CURVES USING THE MONOD EQUATIONS,
W70-09122

EFFECTIVE PHOSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE ACTIVATED SLUDGE PROCESS, OSD 05D

THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXIGEN CONCENTRATION IN THE DELAWARE RIVER, W70-09189

BOD AND COLOR REMOVAL FROM KRAFT MILL WASTES, 05D

BIOCHEMISTRY

EFFECTIVE PHOSPHORUS REMOVAL BY THE ACCITION OF ALUM TO THE ACTIVATED SLUDGE PROCESS,

W70-09186

05D

BIODEGFADATION
SELF-PURIFICATION OF NATURAL WATERS PROM CARBOHYDRATES,
05B

OXIDATION OF ALCOHOLS AND THEIR IMPLUENCE ON THE SELF-PURIFICATION OF NATURAL WATERS, 05B

EFFECTIVE PHOSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE

FIC-BAR ACTIVATED SIUDGE PROCESS, W70-09186 DRAIN INSTALLATION FOR NITRATE REDUCTION W70-09228 BICLOGICAL LIFE
THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN
CONCENTRATION IN THE DELAWARE RIVER,
05C BICLOGICAL TREATMENT

EFFECTIVE PROSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE ACTIVATED SUDGE FROCESS, W70-09786

05D REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBIOSIS, W70-09187 BAFFLED BIOLOGICAL BASIS FOR TREATING POULTRY PLANT WASTES, W70-09320 05D THE SEASONAL FERFORMANCE AND THE PATTERNS OF CHEMICAL AND EIOLOGICAL EVENTS IN SEWAGE LAGOONS, N70-09333 THERMAL ENERGY CONSERVATION AND SEQUENTIAL BIOLOGICAL PROCESSING APPLIED TO SEWAGE LAGOON DESIGN, EFFECT OF TOXIC WASTES ON TREATHENT PROCESSES AND WATERCOURSES, W70-09341 05D MICROBIOLOGY OF A WASTE STABILIZATION POND, BIFCLAE TRANSMISSION LINES
TRANSIENT OVERVOLTAGE ON A BIPCLAR HVDC OVERHEAD LINE CAUSED
FY DC LINE FAULTS,
W70-09018
08C BIEDS
HATER ECONOMY OF THE GREEN-TAILED TOWHEE (CHLORURA ELIGHTS
THE EFFECT OF SOIL HOISTORE LEVEL OF THE INCIDENCE OF EARLY
ELIGHT OW POTATO AND TOMATO PLANTS,
W70-09137
021 BOARD OF ENVISONMENTAL AFFAIRS
CHAPTER 6 FEDERAL ORGANIZATION FOR MANAGING THE
ENVIRONMENT.
N70-09444
06E BOIT FIUITS

BEART RATE AND CHANGES IN BODY FLUIDS IN AESTIVATING TOADS
FROM XERIC HABITATS,
W70-09148

021 BCEDEE IRRIGATION
ON USING A TIME VARIABLE INFILTRATION WITH THE ISRAELSON ECPDEE IRRIGATION EQUATION,
570-09141
03F BOREHOLE GEOPHYSICS AS APPLIED TO GROUNDWATER, B70-09400 07B BOTION SEDIMENTS
ISOPACHOUS HAPPING OF THE LOWER PATURENT ESTUARY SEDIMENTS
OF CONTINUOUS SEISMIC PROFILING TECHNIQUES,
021 BOULDER CANYON PROJECT ACT ARIZONA V CALIFORNIA (RELATIVE RIGHTS IN COLCRADO RIVER EOUNCARIES (PROPERTY)
HONEBEIN V BONTICELLO (DEED TO LAKE FRONTAGE AS NOT EXTENDING CHMERSHIP TO LAKE BED).
W70-09054
06E SANDERS V ROSE (PROPERTY BOUNDARY AS AFFECTED BY CHANGE IN COURSE OF STREAM).

W70-09059

OGE KOEN V CHESAPEARE AND O RY (EFFECT OF CHANGE OF NATURAL WATERCOURSE ON FROPERTY BOUNDARIES). W70-09076 CARTER CIL CO V WATSON (BCUNDABY DISPUTE WHERE LAND CONVEYED ECRDERED ON A SIRRAH). W70-09077 06E THOMAS E BISHOP CO V SANTA BARBARA COUNTY (MEANDER LINES AS ECONGABLES). #70-09082 CITY OF NEW YORK V WILSOH AND CO (EJECTMENT ACTION BY CITY SERVING POSSESSION OF FILLED LANDS ORIGINALLY BRION THE HIGH WATER HABE OF RIVER).

EURAS V EILZEY (POSSESSOFY RIGHTS IN WATERFRONT PROPERTY).

SANDERS V ROSE (PROPERTY BOUNDARY AS AFFECTED BY CHANGE IN M70-09059 DICKSON V SANDEFUR (DISPUTED OWNERSHIP OF LAND APPEARING AFFEB SUDDEN SHIFT IN RIVER'S COURSE).
W70-09060 06E KUHN V CHESAPEAKE AND O RY (EPPECT OF CHANGE OF NATURAL WATERCOURSE ON PROPERTY BOUNDARIES). CARTER OIL CO V WATSON (BOUNDARY DISPUTE WHERE LAND CONVEYER BORDERED ON A STREAM). W70-09077 BLASK V SOWL (OWNERSHIP OF ISLANDS IN NAVIGABLE WATERS). 0.000BLISS V KINSEY (EXTENSION OF BOUNDABY LINES FFOR MEANDER LINE TO SHORE LINE). W70-09343 BPANT LAKE SHORES, INC V BARTON (ADVERSE POSSESSION OF LAND)
BELOW THE HIGH WATER HARK).
W70-09355 UNITED STATES V OTLEY (OWNERSHIP OF LAKE BEDS). W70-09467 BOUNDARY LAYERS
TURBULENT DIFFUSION IN A STABLY STRATIFIED SHEAR LAYER, A STUDY OF FARM WASTE, FARM ANIMAL WASTE CHARACTERIZATION,
HAWELING, UTILIZATION,
W70-09426 05B BOX CULVERIS
ELECTRONIC COMPUTER PROGRAM FOR HYDRAULIC ANALYSTS OF BOX
CULVERTS (BPR PROGRAM HY-3),
W70-09445
088 BP 1002
TOXICITY STUDIES WITH AN OIL-SPILL EMULSIFIER AND THE GREEN ALGA PRASINOCLADUS MARINUS,
W70-09429
05C BREAKWAIERS
WAVE ACTION AND BREAKWAIER LOCATION, VERNILION HARPER, OHIO
HYDRAULIC MODEL INVESTIGATION,
W70-09178
08B BRIDGES
PIKE RAFIDS POWER CO Y MINNEAPOLIS ST P AND S S M RY
(RELATIVE RIGHTS TO RIVER BED AS BETWEEN BRIDGE OWNER AND
DAM CWHER).
W70-09081 ANDERSON Ψ HOBBS TIR AND TIMBER CO (TITLE TO BRIDGE RESTING UPON BIVER DED). $\Psi70-09159$ UNITED STATES V WAUNA TOLL BRIDGE CO (OBSTRUCTION OF NAVIGABLE RIVERS). W70-09466 04A BRINE LISTOSAL
DISPOSAL OF BRINE BY SOLAR EVAPORATION 1 W70-09150 02D FIELD EXPERIMENTS, DETERMINATION OF PORE SIZE BY THE AIR BUBBLING PRESSURE HETHER, W70-09297 BUILDING DESIGN CONSERVATION OF CRAFT SKILLS IN DESIGN, W70-09033 BULINUS TRUNCATUS
COMPARATIVE STUDIES OF THE HOLLUSCICICAL EFFECT OF CUPROUS
CHLORIDE AND COPPER SULFATE IN IRAN,
W70-C9432
05C CITY OF PHILADELPHIA V STANDARD OIL CO (USE OF PUBLIC BULKBEAD BY RIPARIAN OWNER). INVESTIGATION ON THE CONTROL OF FILAMENTOUS BULKING, W70-09509 BUOYANCY BUOYANT PLUMES AND THERMALS, W70-09168 BURIED CABLES
1969 HVDC STRAY CURRENT TESTS ON UNDERGROUND TELEFHONE BURROWS
THE TERRESTRIAL ECOLOGY OF THE SPADEFOOT TOAD SCAPBIOFUS BYPRODUCTS
FLY ASH UTILIZATION CLIMBING STEADILY.

₽70-09040

CADMIUM RELATION BETWEEN THE 'ITAI-ITAI' DISEASE AND THE POLLUTION OF RIVER WATER BY CALMIUS FROM A MINE, W70-09427

CALIERATIONS

COMPARATIVE STUDY OF THE WATER BALANCE IN THE AERATED ZONES
WITH RACIO-ACTIVITE METHODS AND WEIGHABLE LYSIMETER,
02G
02G

MEASURING SOIL MOISTURE IN THE BRENIG CATCHMENT PROBLEMS OF USING NEUTRON SCATTER EQUIPMENT IN SOIL WITH FEATY IAYERS, 770-09264 02G

AN INSTRUMENT FOR MEASURING SOIL MOISTURE EX NEUTFON SCATTERING, W70-09265 07B

CHANGES IN THE MOISTURE CONTENT OF THE TOPSOIL AS MEASURED WITH A NEUTBON MOISTURE GAUGE,

THE DETERMINATION OF SOIL MOISTURE WITH THE NEUTRON SCATTERING METHOD IN FINIAND,

NEUTRON MOISTURE METER FOR SALINE SOILS, \$70-09268 078

FOLISH ISOTOPE APPARATUS FOR RESEARCH ON SOIL MOISTURE, N70-09271 07B

A STUDY ON PRESSURE MEMBRANE PROPERTIES IN RELATION TO CAPILIARY CONDUCTIVITY MEASUREMENTS, 02G

CALIFORNIA
ABIZONA V CALIFORNIA (RELATIVE RIGHTS IN COLORADO RIVER
WATER).

THOMAS E BISHOF CO V SANTA FAREARA COUNTY (MEANDER LINES AS

SUMMARY OF GROUNDWATER OCCURRENCE IN CALIFORNIA, W70-09214 02F

SCHE EFFECTS OF FRESH-WATER INFLOW ON THE FLUSHING OF SOUTH SAN FRANCISCO BAY A PRELIMINABLE FEPORT, W70-09215 05G

HOVEMENT OF SEABED DEIFTERS IN THE SAN FRANCISCO BAY ESTUARY AND THE ADJACENT PACIFIC OCEAN A PRELIMINABLY REPORT, W70-09216 02L

FLOOD PIAIN INFORMATION, SANTA CLARA RIVER, VENTURA COUNTY, CALIFORNIA. W70-09221

A SUMMARY OF PRELIMINARY STUDIES OF SEDIMENTATION AND HYDROLOGY IN BCLINAS LAGCON, MARIN COUNTY, CALIFORNIA, #270-00275

AGE OF QUATERNARY SEDIMENTS AND SOILS IN THE SACRAMENTO ARMA, CALLFORNIA BY URANIUM AND ACTINIUM SERIES DATING OF VERTERATE FOSSILS,

RESEARCH ON WATER QUALITY, W7C-09348

FLOOD PIAIN INFORMATION, COYOTE CRIEK, SAN FRANCISCO BAY TO ANDERSON EESERVOIR, SANTA CLARA COUNTY, CALIFORNIA. W70-09365

DAI SEEFAGE BEDUCTION OF SEEPAGE LOSSES FROM IRRIGATION CANALS AS A BESULT OF SILTING, W70-09043.

CANNEETES
FCONOMICS OF CANNERY WASTE TREATMENT,
W70-09338 05D

CANNERIES (FEACH)

EQUITERENTS AND COSTS OF ALTERNATIVE SYSTEMS FOR TREATING
FEACH CANNERY WASTES.

#70-09183

OGC

CAPILIARY ACTION

HOISTURE CONTENT AND HYDROPHILITY AS RELATED TO THE WATER
CAPILLARY RISE IN SOILS,

02G

CAFILLARY CONDUCTIVITY DATA ESTIMATED BY A SIMPLE HETHOD, 07B W70-09277 07B

A STUDY ON PRESSURE MEMBRANE PROPERTIES IN RELATION TO CAPILLARY CONDUCTIVITY MEASUREMENTS, 02G

AN INFILTRATION METHOD FOR THE DETERMINATION OF THE CAPILLARY CCHDUCTIVITY OF UNLISTURBED SOIL CORES, 870-09281 07B

CETERMINATION OF CAPILLARY CONDUCTIVITY AND DIFFUSIVITY OF

VERIFICATION OF THE GENERALIZED DARCY'S LAW AND
DETERMINATION OF CAPILLARY CONDUCTIVITY AT THE BEGINNING OF
HORIZONAL INFILTRATION (FRENCH),

THE MICROHYDROLOGICAL CHARACTERIZATION OF SOILS, W70-09289 02G

MOISTURE CONTENT AND HYDROPHILITY AS FELATED TO THE WATER CAFILLARY RISE IN SOILS, W70-09296 02G

CAPILLARY WATER
THE NATURE OF THE MINIMAL WATER RETENTIVE CAPACITY,
W70-09302 02G

CAPITAL COSTS
CONTINUOUS COUNTERCURRENT ION EXCHANGE.
W70-09037 05F

CARBCHYDRATE BIODEGRADATION
SELF-PURIFICATION OF NATURAL WATERS FROM CARBOHYDRATES,
W70-09100 05B

CARBOHYDRATES
CONTROL MECHANISMS OPERATIVE IN A NATURAL MICROBIAL POPULATION SELECTED FOR ITS ABILITY TO DEGRADE L-LYSINE, II. EFFECTS OF FRUCTOSE AND RIBOSE IN BATCH SYSTEMS,

05D

CONTROL MECHANISMS OPERATIVE IN A NATURAL MICROBIAL POPULATION SELECTED FOR ITS ABILITY TO DEGRADE L-LYSIME, III. EFFECTS OF CARBOHYDRATES IN CONTINUOUS-FLOW SYSTEMS UNDER SHOCK LOAD CONDITIONS, W70-09337

INDUMATES
A STUDY OF THE HYDROCHEMICAL FACIES OF THE WILCOX AQUIFERS
IN MISSISSIPPI, W70-09095

CARCINOGENIC COMPOUND ALGAL CAUSAL SUBSTANCES IN WASTES FROM THE COAL CHEMICAL INDUSTRY, W70-09437 05C

CARRIERS
MINERAL METABOLISM OF HALOPHYTES,
W70-09147

CATHODIC PROTECTION OF THE BONNEVILLE POWER ADMINISTRATION'S 34.5 KV SAN JUAN ISLANDS CABLE, W70-09013 08C

INTERNAL CATHODIC PROTECTION OF WATER COOLED PLANT,

CATTLE SKIN WASTE
CATTLE SKIN TANNERY WASTES TREATMENT IN A COMPLETELY MIXED
ACTIVATED SLUDGE PILOT PLANT,
W70-09224
05D

CELL SAP

EFFECT OF VARIATIONS IN SUBSTRATE SALINITY ON THE WATER
BALANCE AND IONIC COMPOSITION OF BEAN LEAVES,

021

CELLULCSE
DEVELOPMENT OF REVERSE OSMOSIS MEMBRANES,
W70-09362
03A

CENTEAL CHERNOZEM REGION
WATER BALANCE AND SILTING OF SMALL RESERVOIRS IN THE CENTRAL
CHERNOZEM OF THE RUSSIAN SOVIET FEDERAL SOCIALIST BEPUBLIC.
02J

CENTRAL HEATING AND COOLING SPACE HEATING IN URBAN ENVIRONMENTS, W70-09192

USES OF WASTE HEAT, W70-09193

CENTRIFUGAL PUMPS
PLOW OF ENTRAINED AIR IN CENTRIFUGAL PUMPS,
08C

CHANNEL FICH KUHN V CHESAPEAKE AND O RY (EFFECT OF CHANGE OF MATURAL WATERCOURSE ON PROPERTY BOUNDARIES). 06E

CHANNEL IMPROVEMENT
YEARSLEY V W A ROSS CONST CO (LIABILITY OF PRIVATE CCRPORATION ACTING PURSUANT TO AN ACT OF CONGRESS).

066

MOHANK CARPET MILLS, INC V STATE (FLOODING CAUSED BY STATE'S NECLIGENCE IN CANAL CONSTRUCTION).

CITY OF PHILADELPHIA W STANDARD OIL CC (USE OF PUBLIC BULKHEAD BY RIPARIAN OWNER).

BEHRENS V CITI OF MINNEAPOLIS (PUBLIC PURPOSE REQUIREMENT FOR CHANNEL IMPROVEMENT).

W70-09496

#70-09#89

CHANNEL MCFFEOLOGY STREAM CRDER AS A MEASURE OF SAMPLE SOURCE UNCERTAINTY, \$70-09202 02J

COMPUTATION OF THE DEFORMATION OF BARS AND NAVIGATION CHANNELS,

CHANNELS
SANDERS W ROSE (PROPERTY BOUNDARY AS APPECTED BY CHANGE IN CCURSE CF STREAM).
W70-09059
06E

CHARACTERISTICS
TREATMENT OF DAIRY MANURE BY LAGOONING,
170-09335
05D

THICKENING CHARACTERISTICS OF ACTIVATED SLUDGE, W70-09505

CHECK IRRIGATION

HYDRAULIC DESIGN FOR CHECK METHOD OF IRRIGATION,
W70-09136

03F

CHEMICAL ABALISIS
A STUDY OF THE HYDROCHEMICAL FACIES OF THE WILCOX AQUIFERS
IN MISSISSIFPI,
W70-09095
02K

CHEMICAL DEGRADATION

EFFECTIVE PHOSPHOBUS REMOVAL BY THE ADDITION OF ALUE TO THE

ACTIVATED SIDDGE FROCESS,

W70-091E6

05D

CHEMICAL HANDIING ADVANCES IN HANDLING GAS CHLORINE, \$70-09319

CHEMICAL CRYGEN DEMAND
THE EFFECT OF BIOLOGICAL LIPE ON THE DISSOLVED ORYGEN
CONCENTRATION IN THE DELAWARE RIVER,
0.50

CHEMICAL FRECIPITATION

IFFECTIVE PROSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE
ACTIVATED SUDGE FRECESS,
#70-09186

05D

CHEMICAL FROPERTIES
THE SEASONAL FERFORMANCE AND THE PATTERNS OF CHEMICAL AND ETOLOGICAL EVENTS IN SEWAGE LAGOONS,

05D

CHEMISTRY OF FRECIPITATION
CHEBICAL CORFESITION OF PRECIPITATION IN REGIONS OF THE
SOVIET UNION,
870-09133
02B

CHEMICAL HYDROLOGY OF REGIONS OF EAST ANTARCTICA, N70-09134 02K

CHERNOZEMS
INFLUENCE OF SOIL STRUCTURE ON INFILTRATION AND PF VALUES OF CHERNOZEM AND CHERNOZEMLIKE DARK MEADOW SOILS, W70-09294

O2G

INFILTRATION PROPERTIES OF THE SOILS OF THE CENTRAL CHERNCZEM FECUINCES, W70-09313

ELEMENTS OF THE WATER BALANCE OF SHALL RESERVOIRS OF THE CENTRAL CHERNOZEM PROVINCES, 870-09314 02H

SMALL RESERVOIRS AND PONDS OF THE CENTRAL CHERNOZEM EROVINCES, ESFSE, 170-09415

CHICKERS
FAFFLED BIOLOGICAL BASIS FOR TREATING POULTRY PLANT WASTES,
W70-09320
05D

CHICKEFAS
FACTORS AFFECTING SEED GERMINATION UNDER SOIL MOISTURE
STRESS,
W70-09135

CHICRINATION
ACVANCES IN HANDLING GAS CHIORINE,
670-09319
05D

CHICRINE
ACVANCES IN HANGLING GAS CHLORINE,
W70-09319
050

CITIES

CITY OF NEW YORK W NEW YORK WATER SERVICE CORP (CITY MAY
CREER AN INCREASE IN WATER SUPPLY).

W70-09025

NEW YORK BETROPOLITAN REGION--- MAJOE SEDIMENT SOURCE, W70-09203

EFFGER V OHISON (NO ABSOLUTE RIGHT TO TOLL PREE USE OF GCVERNMENT CONTROLLED DOCK). W70-09469 06E

ECCKFORD PAPER BILLS, INC V CITY OF ROCKFORD (FLOOD DAMAGE TO DAM AND OTHER PROPERTY FROM HEGLIGENT DAM OPERATION).

CITY PLANNING SOIL, WATER AND SUBURBIA. W70-09188

06E

04 A

CLAIM (CONTRACTS)
PETERSON V UNITED STATES (PUBLIC WORK INCLUDES FLOOD CONTRO O
AND IMPROVEMENTS TO NAVIATION).
W70-09471
O4A

CLASSIFICATION
THE MICRCHYDROLOGICAL CHARACTERIZATION OF SOILS,
W70-09289 02G

CLAY MINEFALS
OBSERVATIONS ON ACTIVITY AND DIFFUSION COEFFICIENTS IN NAHORTMCKILLONITE,
W70-09105
02K

EXPERIMENTS ON THE ADSORPTION OF AMMONIUM IONS BY CLAY PARTICLES IN NATURAL WATERS,

FINAL BEPORT ON REVERSE OSMOSIS MEMBRANES CONTAINING GRAPHITIC OXIDE, W70-09245

CLAYS
EFFECTS OF RAINFALL ON SETTLING VELOCITY OF SUSPENCED
SECTMENT IN QUIESCENT WATER,
W70-09120
02J

ON THE ADDESION OF PORE WATER IN FINNISH ARGILLACECUS SETTMENTS OF DIFFERENT AGE, W70-09195 02G

EFFECTS OF SALTS AND ORGANIC MATERIALS ON THE HYDRAULIC CONDUCTIVITY OF THE SOILS,

CLEAR-CUTTING
EFFECTS OF FOREST CLEAR-FELLING ON THE STORM HYDRCGRAFH,
W70-09117
03B

CLIMATIC DATA
WATER VAPOR BALANCE OF THE ATMOSPHERE FROM FIVE YEARS OF
HEMISFHEBIC DATA,
W70-09238
02B

CLIMATOLOGY
INFLUENCE OF EVAPORATION FROM LAKE BAIKAL ON PRECIPITATION
IN THE SURROUNDING REGIONS,
W70-09096
02D

WATER VAPOR BALANCE OF THE ATHOSPHERE FROM FIVE YEARS OF HEMISPHERIC DATA, 870-09238 02B

SOIL MOISTURE PRESSURE IN SOME CLIMATIC ZONES, #70-09291 02G

A SELECTED ANNOTATED BIBLIOGRAPHY OF ENVIRONMENTAL STUDIES OF POLAND, W70-09456 02B

CLOUDBURSIS
PLOOF OF AUGUST 1969 IN VIRGINIA,
W70-09234 021

COASTAL ENGINEERING USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING, $\Psi 70-9029$

COLD RESISTANCE
TRMPERATURE-DEPENDENT CHARACTERISTICS OF PERIPHERAL NERVES
EXPOSED TO DIFFERENT THERMAL CONDITIONS IN THE SAME ANIMAL,
W70-09160
05C

EFFECT OF TEMPERATURE SHOCK ON THE TEMPFRATURE RESISTANCE OF POIKTICTHERN AQUATIC ANIMALS. EXPERIMENTS ON THE FROBLEM OF HEAT AND COLD-HARDENING IN ANIMALS (GERRAN), 05C

COLIFORM
NITRATE VARIATION IN GROUNDWATER,
W70-09425 05

COLOR BOD AND COLOR REMOVAL FROM KRAFT HILL WASTES, W70-09330 05D

COLORADO V KANSAS (APPORTIONMENT OF WATER BETWEEN UPRIVER AND DOWNRIVER STATES). 06E

LONDON EXTENSION MINING CO V ELLIS (OWNERSHIP OF ACCRETED LANDS). W70-09465 06E

COLORADO RIVER
ARIZONA V CALIFORNIA (RELATIVE RIGHTS IN COLORADO BIVER
WATER).
06P

COMBINED SENERS
THE OPTIMIZATION OF STORM-HOLDING TANKS A PROBLEM OF WATER
FOLIUTION CONTROL,
H70-09181
056

SUBJECT INDEX

CPEACTION
ON THE ADDRESSION OF FORE WATER IN PINNISH ARGILLACEOUS
SEDIMENTS OF DIFFERENT AGE,
0.2G

OFFENSATION LANFORT V UNITED STATES (COMPENSATION FOR TAKING OF PRIVATE FROFERTY). $\label{eq:condition} \textbf{L} \textbf{1} \textbf{C} - \textbf{0} \textbf{9} \textbf{0} \textbf{6} \textbf{9}$

YEARSLEY W WA ROSS CONST CO (LIABILITY OF PRIVATE COMPORATION ACTING PURSUANT TO AN ACT OF CONGRESS). W70-0907C 06E

UNITED STATES V WILLOW RIVER POWER CC (IMPAIRED EFFICIENCY OF HYDROCFLECTRIC PLANT CAUSED BY RAISING THE WATER LEVEL OF THE RIVER ON WHICH IT WAS LOCATED).

W70-09073 06E

EUKE FORER CO V TOMS (POWER CCMFANY'S RIGHT TO FLOOD ACCCMFANIED BY DUTY TO PAY DAMAGES). 06E

EARCOCK V MISSISSIPPI RIVER POWER CO (INJURY TO LAND VIA DAM CONSTRUCTION).

UNITED STATES V DICKINSON (GOVERNMENT'S LIABILITY FOR EROSION CAUSED BY FLOODING).

EEARD'S ERIE EASIN W NEW YORK (RIGHTS TO COMPENSATION AWARD EASID ON OWNERSHIP OF LANDS CONDEMNED). 06E

UNITED STATES V WILLIS (LIABILITY FOR PLOOD DAMAGE).

THOMESON W CITY OF PHILADELPHIA (DAMAGE CAUSED BY CITY MAINTAINED SEWAGE SYSCEM).

CLSEN V CITY OF DEARBORN (EVALUATION OF PROPERTY FARTIALLY TAKEN FOR PUBLIC UTILITY PURPOSES). W70-09491 06E

CONFULER FRCGFARS
FOUNDATION SETTLEMENT AND GROUND REACTION CALCULATIONS USING
A DIGITAL COMPUTER,

A METHOD FOR THE EVALUATION OF THE SYSTEM AND COST EFFECTIVENESS OF LARGE SEA WATER DISTILLATION PLANTS, 870-09247

SOME NUMERICAL METHODS FOR SOLVING PROBLEMS OF NON-STEADY SEEPAGE IN NON-HOMOGENEOUS ANISOTROPIC SOILS, W70-09309 02G

COMEUTER-AIDER DESIGN LETAILING BY COMPUTER, W70-09035

FCUNDATION SETTLEMENT AND GROUND REACTION CALCULATIONS USING A DIGITAL COMPUTER,

CONCERTE CONSTRUCTION
CONSERVATION OF CRAFT SKILLS IN DESIGN,
W70-09033

CONCRETE DAMS
CONTROL AND REPAIR OF CRACKS IN CONCRETE DAMS,
#70-09019

CONCRETE ESOPERTIES
A REVIEW OF STRESS-STRAIN RELATIONSHIPS FOR CONCRETE,
W70-09032

CONCRETE STRUCTURES
LETAILING BY COMPUTER,
#70-09035

CONCRETE TECHNOLOGY

A REVIEW OF STEESS-STRAIN RELATIONSHIPS FOR CONCRETE,

#70-09032

CONCRETES A REVIEW OF STRESS-STRAIN RELATIONSHIPS FOR CONCRETE, A70-09032

CONDENNATION
FLORIDA BLUE RIDGE CORP V TENNESSEE ELECTRIC POWER CO
(BELATIVE RIGHTS IN PROPERTY SUBJECT TO EASEMENTS).

06E

SIXDE MOUNTAIN REALTY CO V STATE (CONDEMNATION VALUE OF A WATER BODY AND DAM).
W70-09158

TANFORTE V UNITED STATES (CONDEMNATION VALUE OF EASEMENT FOR FLOCE CONTROL PURPOSES). 06E

UNITED STATES W DICKINSON (GOVERNMENT'S LIABILITY FOR BROSION CAUSED BY FLOODING). Q4A

EEARD'S ERIE EASIN W NEW YORK (RIGHTS TO COMPENSATION AWARD EASED ON CONDENSHIP OF LANDS CONDENNED). 062

UNITED STATES V WILLIS (LIABILITY FOR FLOOD DAMAGE).

UNITED STATES V WAUNA TOLL BRIDGE CO (OBSTRUCTION OF NAVIGABLE RIVERS). 04A

CONDEMNATION VALUE
IN RE EAST RIVER DRIVE (VALUATION OF SCENIC FASEMENTS IN
CONDEMNATION PROCEEDINGS).
W70-09062
06E

DANFORTH V UNITED STATES (COMPENSATION FOR TAKING OF PRIVATE PRCPERTY) ...

UNITED STATES V DICKINSON (EMIMENT DOMAIN BY RAISING LEVEL OF RIVER PURSUANT TO CONSTRUCTION OF DAM). W70-09074

UNITED STATES V WABASHA-NELSON BRIDGE CO (COMPENSATION FOR CONSEQUENTIAL DAMAGES TO CONDEMNED RIGHT-OF-WAY). W70-09084

SLIDE MOUNTAIN REALTY CO V STATE (CONDEMNATION VALUE OF A WATER FORY AND DAM). 06E

DANFORTH V UNITED STATES (CONDEMNATION VALUE OF EASEMENT FOR FLOOT CONTROL PURPOSES). W70-09164

UNITED STATES BY REL TVA V POWELSON (CONDEMNATION

UNITED STATES V DICKINSON (GOVERNMENT'S LIABILITY FOR EROSION CAUSED BY FLOODING).

UNITED STATES V WILLIS (LIABILITY FOR FLOOD DAMAGE). W70-09464

CONTINENTAL LAND CO V UNITED STATES (CONDENNATION VALUE OF LANDS TO BE FLOODED BY A DAM).

KARLSON V UNITED STATES (CONDEMNATION OF FLOWAGE EASEMENT OVER RIPARIANS'S LANDS). 06E

UNITED STATES V CHICAGE B AND Q RE (EXTENT OF JUST COMPENSATION IN CONDEMNATION PROCEEDING). W70-09482

OLSEN V CITY OF DEARBORN (EVALUATION OF PROPERTY PARTIALLY TAKEN FOR PUBLIC UTILITY PURPOSES). W70-09491 06E

CONDITIONED RESPONSE

EFFECTS OF SUBLETHAL DDT ON A SIMPLE REFLEX IN BRCCK TROUT,

#70-09428

05C

CONDUCTIVITY THE EFFECT OF TEMPERATURE ON WATER FLOW IN SOILS, 02G

CONFERENCES
MINING AND GROUNDWATER GEOPHYSICS/1967.
W70-09392
07B

CONFINED WATER
PUNDING TESTS AND HYDROGEOLOGICAL INVESTIGATIONS OF AN
ARTESIAN AQUIPER NEAR HORSENS, DENHARK,
W70-09237
02F

CONJUGATE GRADIENT NETHOD
OPTIMIZATION OF WATER RESOURCES SYSTEMS BY THE GRADIENT
PROJECTION AND THE CONJUGATE GRADIENT METHODS,
06A

CONSEQUENTIAL DAMAGES
UNITED STATES V DICKINSON (GOVERNMENT'S LIABILITY FOR
EROSION CAUSED BY FLOODING).
W70-09462
04A

CONSERVATION
THERMAL EMERGY CONSERVATION AND SEQUENTIAL BIOLOGICAL
PROCESSING APPLIED TO SEWAGE LAGOON DESIGN,
W70-09334
05D

COASTAL WETLANDS OF WIRGINIA-INTERIM REPORT, 02L

CONSOLIDATION
THICKENING CHARACTERISTICS OF ACTIVATED SLUDGE,
W70-09505

CONSTITUTIONALITY
PUERTO RICO V RUSSELL AND CO (IMPOSED TAX AS IMPAIRMENT OF
CONTRACT FOR WATER SUPPLY).
W70-09072
06E

CONSTRUCTION CONTROL
CONTROL AND REPAIR OF CRACKS IN CONCRETE DAMS,
W70-09019 08F

CONSTRUCTION COSTS
CONSERVATION OF CRAFT SKILLS IN DESIGN,
W70-09033

CON-DAM CONSUMETIVE USE
WATER USE BY SALT CEDAR,
W70-09113 02D CONTACT STABILIZATION
AFRATED LAGCONS TREAT SECONDARY EFFLUENT,
W70-09331 05D CONTAMINATION
IMPULSE DISCHARGE ON CONTAMINATED SURFACE,
W70-09039 08C CONTEMPT (LEGAL ASPECTS)
BROOKS V UNITED STATES (JURISLICTION OF FEDERAL COURT TO LETERMINE WATER RIGHTS IN INTERSTATE RIVER).

06E CONTINUOUS EEAMS LETAILING BY COMPUTER, 870-09035 CONTINUOUS-PLCW
CONTROL BECHANISMS OFERATIVE IN A NATURAL BICROBIAL
EOPULATION SELECTED FOR ITS ABILITY TO DEGRADE L-LYSINE,
III. EFFECTS OF CAREOHYLPATES IN CONTINUOUS-FLOW SYSTEMS
UNDER SBOCK LOAD CONDITIONS, 05D CONTRACTS FUERTO BICO V RUSSELL AND CO (IMPOSED TAX AS IMPAIRMENT OF CONTRACT FOR WATER SUPPLY). W70-09072 06E CONTECT
CONTECT HECHANISMS OPERATIVE IN A NATURAL MICROBIAL FOPULATION SELECTED FOR ITS ABILITY TO DEGRADE L-LYSINE, II. EFFECTS OF FRUCTOSE AND RIBOSE IN BATCH SYSTEMS, W70-09336 CONTROL MECHANISMS OPERATIVE IN A NATURAL MICROBIAL FOPULATION SELECTED FOR ITS ABLILITY TO DEGRADE L-LYSINE, III. EFFECTS OF CARBOHYLRAFES IN CONTINUOUS-PLOW SYSTEMS UNDER SHOCK LOAD CONDITIONS, AUTOMATED ACTIVATED SLUDGE PLANTS WITH RESPIRATORY BETABOLISM CONTROL, W70-09502 INVESTIGATION ON THE CONTROL OF FILAMENTOUS BULKING, W70-09509 05D CONVESTIRS (ELECTRICAL)
FREITCTION OF BELIABILITY AND AVAILABILITY OF HYDC VALVE AND
BYDC TEFHINAI,
W70-09017
08C COCIING
SFACE HEATING IN URBAN ENVIRONMENTS, USES OF WASTE BEAT, W70-09193 CCCLING WATER BEAT WASTE, W70-09162 05P EFFECTS OF THERMAL DISCHARGE FROM THE SAN ONOFRE NUCLEAR GENERATING STATION, CCFFEE SUIFATE
CCMPARATIVE STUDIES OF THE MOLLUSCICIDAL EFFECT OF CUPROUS
CELOBIDE AND COPPER SULFATE IN IRAN,
B70-09432
05C COSE DESILLING
CW GEOLOGICAL AND TECHNOLOGICAL ASPECTS OF OBSENTED W-SIZE
CORE DIAMOND DRILLING, COMPLEX EQUIPMENT FOR SINKING AND DRILLING OF VERTICAL SHAFIS. N70-09447 CCFF SECOVERY
CM GEOLOGICAL AND TECHNOLOGICAL ASPECTS OF ORIENTED M-SIZE
CCFF DIAPCNE DEILLING,
W70-09028
08E OH GEOLOGICAL AND TECHNOLOGICAL ASPECTS OF ORIENTED H-SIZE CORE DIAMOND DELLLING, N70-09028 COBELEATION AWALYSIS
CHARACTERISTICS OF WASTEWATER AT DELHI,
W70-09327
05D

CCEROSION
1969 HVDC STRAY CURRENT TESTS ON UNDERGROUND TELEPHONE CAPLES,
870-09015
08C

COEFOSION CONTROL
INTERNAL CATHODIC PROTECTION OF WATER COOLED PLANT,
W70-09014 08C

A METHOD FOR THE EVALUATION OF THE SYSTEM AND COST EFFECTIVENESS OF LARGE SEA WATER DISTILLATION PLANTS, \$170-09247 COST CCMFARISONS
REQUIREMENTS AND COSTS OF ALTERNATIVE SYSTEMS FOR TREATING:
PEACE CANNERY WASTES.
W70-09183
06C COST-BENEFIT ANALYSIS
TIME BIAS IN RECREATION BENEFIT ESTIMATES,
W70-09110
06A COST-EFFECTIVENESS AMALYSIS
A METHOD FOR THE EVALUATION OF THE SYSTEM AND COST
EFFECTIVENESS OF LARGE SEA WATER DISTILLATION PLANTS, CRACK CONTROL CONTROL AND REPAIR OF CRACKS IN CONCRETE DAMS, W70-09019 08F CONTROL AND REPAIR OF CRACKS IN CONCRETE DAMS, CONTROL AND REPAIR OF CRACKS IN CONCRETE DAMS, SOIL TEMPERATURE AND WATER CONTENT CHANGES DURING DRYING ASSIMPLOENCED BY CHACKS A LABORATORY EXPERIMENT, W78-09379 02G CRAFTS
CONSERVATION OF CRAFT SKILLS IN DESIGN,
a70-09033 08F CRITICAL THERMAL MAXIMA
PHYSIOLOGICAL RESPONSES TO TEMPERATURE AND DESICCATION IN
THE ENDEMIC NEW HEXICO PLETHODONTIDS, PLETHODON NECHEXICANUS:
AND ANEIDES HARDII,
W70-09145
021 CROP PECDUCTION FORACE CROP IRRIGATION WITH OXIDATION POND EFFLUENT, W70-09423 05D PADDY RATCONS, W70+09501 CROPS
DALY W NEW YORK (DAMAGES TO CROPS FROM BARGE CANAL CONSTRUCTION).
W70-09061
06E DIGESTED SLUDGE DISPOSAL ON CROP LAND, W70-09328 ODE CALL
PRELIMINARY RESULTS OF THE EXPERIMENTS ON THE TOXICITY OF
OIL COUNTERACTING AGENT (ESSO COREXIT 7664), WITH AND
WITHOUT IRAQ CRUDE OIL, FOR SELECTED MEMBERS OF MAKINE COLVERTS
ELECTRONIC COMPUTER PROGRAM FOR HYDRAULIC AMALYSIS OF BOX CULVERTS (SPR PROGRAM HY-3), 08A CUPROUS CELORIDE
COMPARATIVE STUDIES OF THE HOLLUSCICIDAL PEFFCT OF CUPROUS
CHLORIDE AND COPPER SULFATE IN IRAN,
H70-09432
05C JRRENI METERS
DISPERSION PREDICTION FROM CURRENT METERS, W70-09219
02E CORRENTS (WATER)

NOTES ON A THEORY OF THE THERMOCLINE,

W70-09191 05B MOVEMENT OF SEABED DRIFTERS IN THE SAN FRANCISCO BAY ESTUARY AND THE ADJACENT PACIFIC OCEAN A PRELIMINARY REFERT, 02L 02L DEPOSITION OF FINE-GRAINED SUSPENDED SEDIMENT FROM TIDAL CURRENTS, W70-09232 CURRENT (WATER)
ENVIRONNENTAL CHANGES PRODUCED BY COLL-WATER OUTLETS PROM
THREE ARKANSAS RÉSERVOIRS,
W70-09384
06G DAIRY INDUSTRY
RESPONSE OF DAIRY WASTE ACTIVATED SIUDGE TO EXPERIMENTAL
CONDITIONS AFFECTING PH AND DISSOLVED OXYGEN CONCENTRATION,
05D TREATMENT OF DAIRY HANDRE BY LAGOONING, W70-09335 DAM CONSTRUCTION
JAMES V DRAVO CONTRACTING CO (STATE'S RIGHT TO TAX PEDERAL

DESALTING COST CALCULATING PROCEDURES, W70-09241 03A

COST ANALYSIS

DAM-DES

GOVERNMENT'S CONTRACTORS).

DUKE POWER CO V TOMS (POWER COMPANY'S RIGHT TO FLOOD ACCOMPANIED BY DUTY TO PAY DAMAGES).

SUBJECT INDEX

MCAILISIER V SICAN (FLOODING OF PROPERTY DUE TO DAM CONSTRUCTION). W70-09085 06E

TADUI EROOK CO V WILLOW RIVER POWER CO (LIABILITY POR DAM FAILURE DURING UNPRECEDENTED FLOOD) . OGE

AK FOUNDATIONS

BESERVOIF LEAKAGE IN LIMESTONE TERRAINS,

W70-09042

RESEARCH INTO THREE-DIMENSIONAL SEEPAGE IN JOINTED BOCK FOUNDATIONS OF HIGH DAMS.
E7C-09050 04A

CAMAGES

DAVIS V CITIES SERVICE OIL CO (LIABILITY FOR DAMAGES CAUSED BY CIL ECILETICE). 670-09243

DABS

CKLAHCMA EX REL FHILLIPS V GUY F ATKINSON CO (INJUNCTION PGAINST DAB CONSTRUCTION).

06E #70-09071

UNITED STATES W DICKINSON (EMINENT DOMAIN BY RAISING LEVEL OF FIVER PURSUANT TO CONSTRUCTION OF DAM). W70-09074 06E

UNITED STATES V WABASHA-NELSCH BRIDGE CO (COMPENSATION FOR CONSEQUENTIAL DAMAGES TO CONDENNED RIGHT-OF-WAY). 06E

FINITE ELEMENT METHOD OF ANALYZING STEADY SEEPAGE WITH A FREE SUFFACE, #70-09198 0 2 G

INLAND FOWER AND LIGHT CC V GBIEGER (FLOOD DAMAGE FROM NECLIGENT DAM CFERATION). 04A

CONTINENTAL LAND CO V UNITED STATES (CONDEMNATION VALUE OF IANDS TO BE FLOOLED BY A DAM). 06E

TOWN OF HAUSAUKEE V LAUERMAN (LIABILITY FOR FLOOD DAMAGES). 0.04

FOCKFORD PAFER MILLS, INC V CITY OF ROCKFORD (FLOOD DAMAGE TO TAM AND CTHER PROPERTY FROM NEGLIGENT DAM OPERATION). 170-09496

BESERVOIR LEAKAGE IN LIMESTONE TERRAINS, 676-09042

VERTE RIVER IRRIGATION AND POWER DIST V SALT RIVER VALLEY WATER USERS ASS N (CONTRACTUAL RIGHTS TO DAMSITE) - W70-09083

MCALLISIES V SLOAN (FLOODING CF PROPERTY DUE TO DAM CCMSISUCTION). 97C-09085

CONTINENTAL LAND CO W UNITED STATES (CONDEMNATION VALUE OF IANDS TO BE FLOODED BY A DAM). QGE

DARCYS LAW VERIFICATION OF THE GENERALIZED DARCY'S LAW AND DETERMINATION OF CAPILLARY CONDUCTIVITY AT THE BEGINNING OF ECHICONAL IMPLITRATION (FRENCH),

DATA COLLECTIONS
A PROPOSED STREAMFLOW DATA PROGRAM FOR MAINE, W70-09353

STUDY OF THE USE OF ABETAL AND SATELLITE PHOTOGRAMMETRY FOR SURVEYS IN SYDO-09454 073

DATA FROCESSING
USE OF TOPOLOGIC INFORMATION IN PROCESSING DATA FOR CHANNEL NETHCEKS,
W70-09204
07C

DECISION MAKING
FLANNING OUE FUTURE WATER RESOURCES,
W70-09153
06B

DEEP PERCCIATION
HYDRAULIC DESIGN FOR CHECK METHOD OF IRRIGATION,
W70-09136

DEFORMATION A REVIEW OF STRESS-STRAIN RELATIONSHIPS FOR CONCRETE, A REVIEW OF STRESS-STRAIN RELATIONSHIPS FOR CONCRETE, 470-09032

DEGRADATION (DECOMEOSITION)
THE EFFECT OF SALINITY ON THE OXIDATION OF HYDROCARBONS IN ESTUARIBE ENVIRONMENTS,

05B

ANIONIC AND NONIONIC SURFACTANT SORPTION AND DEGRADATION BY CULTURES.

DELAWARE ESTUARY
THE EXPECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN
CONCENTRATION IN THE DELAWARE RIVER,
05C

DELAWARE RIVER
RESERVOIR EFFECT ON DOWNSTREAM WATER TEMPERATURES IN THE
UPPER DELAWARE RIVER BASIN,
05a

THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN CONCENTRATION IN THE DELAWARE RIVER, W70-09189 05C

LHI CHARACTERISTICS OF WASTEWATER AT DELHI, 05D W70-09327

TIME BIAS IN RECREATION BENEFIT ESTIMATES, W70-09110 06A

DEMINERALIZATION
DRY LANCS AND DESALTED WATER, W70-09030

CONTINUOUS COUNTERCURRENT ION EXCHANGE. . 05F $\,$

DENITRIFICATION
DRAIN INSTALLATION FOR NITRATE REDUCTION,
W70-09228
056

PUMPING TESTS AND HYDROGEOLOGICAL INVESTIGATIONS OF AN ARTIESTAN AQUIFER NEAR HORSENS, DENHARK, 02F

DENSITY STRATIFICATION
TWO LAYER MODEL OF STRATIFIED FLOW IN AN ESTUARY,
W70-09152 02L

DEPOSITION (SEDIMENTS)
DEPOSITION OF FINE-GRAINED SUSPENDED SEDIMENT FROM TIDAL CURRENTS,
W70-09232
02L

DESALINATION
ENGINEERING AND ECONOMIC EVALUATION STUDY OF REVERSE
OSMOSIS,
W70-09363
03A

DESALINATION APPARATUS

MANUAL ON SOLAR DISTILLATION OF SALINE WATER,

W70-09244

03A

HYDROCASTING REVERSE OSMOSIS MEMBRANES,

DESIGN AND CONSTRUCTION SYSTEM FOR THE DETERMINATION OF TRANSFORT AND COMPACTION COEFFICIENTS OF REVERSE OSMOSIS MEMBERNES, #70-09356

THE DETERMINATION OF THE TRANSPORT COEFFICIENTS OF CELLULOSE ACETATE MEMBRANES, 870-09357

COMPACTION THEORY FOR MODIFIED REVERSE OSMOSIS MEMERANES,

COMPACTION OF CELLULOSE ACETATE MEMBRANES,

DESALINATION PLANTS
DESALTING COST CALCULATING PROCEDURES,
W70-09241
03A

A METHOD FOR THE EVALUATION OF THE SISTEM AND COST EFFECTIVENESS OF LARGE SEA WATER DISTILLATION PLANTS, W70-09247

SUFFERVISION, CONSTRUCTION AND EVALUATION OF A SEA WATER DESULPATING PROCESS PILOT PLANT, 03A

WATER TECHNOLOGY, W70-09361

DESALINATION PROCESSES
HANDAL ON SOLAR DISTILLATION OF SALINE WATER,
W70-09244
03A

DISTILLATION DIGEST VOLUMES 1 AND 2. 03A

WATER TECHNOLOGY, W70-09361

DESCALING
SUPERVISION, CONSTRUCTION AND EVALUATION OF A SEA WATER
DESULFATING PROCESS PILOT PLANT,
03A

DESIGN

CES-CRA	-
THERMAL ENERGY CONSERVATION AND SEQUE PROCESSING APPLIED TO SEWAGE LAGCON DI 170-09334	NTIAL BIOLOGICAL ESIGN, 05D
DESIGN PRACTICES ETTAILING BY COMPUTER, W70-09035	08F
DESIGNERS CONSERVATION OF CRAFT SKILLS IN DESIGNER W70-09033	N, 08P
DESCRIPTION CURVES AN EMPIRICAL EXPRESSION FOR THE DESCRIPTOR TO T	PTION CURVE, 02G
DETERGENTS A STATEMENT ON FHOSPHORUS, E70+09325	05D
ANIONIC AND NONIONIC SURFACTANT SORPT: ALGAE CULTURES, W70-C9438	OSC DEGRADATION BY
DIAMONE DEILLING ON GEOLOGICAL AND TECHNOLOGICAL ASFECTORS DIABONE DEILLING, W70-09028	TS OF ORIENTED N-SIZE
DIATOMACEOUS-EARTH FILTRATION CF WASTE FLANT EFFICIENTS, W70-09317	05D
DIFFUSION CBSERVATIONS ON ACTIVITY AND DIFFUSION FORTHURILLONITE,	
W70-09105 TUREULENT DIFFUSION IN A STABLY STRAT	OZK
W70-09173	08B
DISPERSION FREDICTION FROM CUBRENT MET W70-09219	TERS, 02E
SCLUTIONS OF THE NON-LINEAR DIFFUSION GRAVITY TERE IN BYDECLOGY, W70-09308	EQUATION WITH A
DIFFUSIVITY FACTORS ASSECTING SEED GERMINATION UNS STRESS, 870-05135	DER SOIL MOISTURE
DIFFUSIVITY DETERMINATION BY A NEW CU	
W70-09278	07в
SCII WATER DIFFUSIVITY AND WATER CONT. CUTFLOW EXPERIMENT, 470-09280	ENT DISTRIBUTION DURING
DIVERGENCES BETWEEN EXPERIMENTAL AND SCAFFILLARY DIFFUSIVITY (FRENCH), W70-09285	
ANALYSIS OF SOME FACTORS AFFECTING THE	
CIFFUSION IN SOILS, W70-C9295	02G
IBE EFFECT OF TEMPERATURE ON WATER PLONTO-09345	OW IN SOILS, 02G
DIGESTION DEGRADATION OF WASTE WATER ORGANICS I W7C-09329	N SOIL, 05E
DIGITAL CCMEDIERS A LINEARIZATION TECHNIQUE FOR THE STU- W70-09307	DY OF INFILTRATION, 02G
DIRES FEANKLIN V UNITED STATES (CONSEQUENT), LIKE CONSTRUCTION IN IMPROVEMENT OF N. W70-09080	AL DAMAGE FROM FEDERAL AVIGATION). 06E
W A ROSS CONST CO Y YEARSLEY (GOVERNM: DAMAGES ABISING FROM IMPROVEMENT OF N W70-09163	ENTAL LIABILITY FOR AVIGATION). 06E
GCOLMAN V UNITED STATES (PEDERAL GOVE FLOCD DAMAGE). W70-09473	RNMENT'S LIABILITY FOR
HOGUE V WONONA-HARRISON DRAINAGE DIST FFORERTY FROM FICOLING CAUSED BY DRAI W70-09494	(PROTECTION OF PRIVATE NAGE IMPROVEMENTS).
DICGENES EICRISTIMANUS EFFECT OF TEMPERATURE AND SALINITY ON THE EIRBIT CRAB, DIOGENES BICRISTIMAN W70-09166	THE HEAT TOLERANCE IN US, 05C
DIQUAT EFFECTS OF DIQUAT ON BLUEGILLS AND THE W70-09431	EIR FOOD ORGANISMS, 05C
DIQUAT RESIDUES EFFECTS OF DIQUAT ON BLUEGILLS AND TH W70-09431	EIR FOOD ORGANISMS,

DIFFCT FEMFFITS
CROSBY W DE LAND SPECIAL DRAINAGE DIST (VALUE TO FARMLAND OF

```
IMPROVED DRAINAGE SYSTEM) .
DIRECT CURRENT 1969 HVDC STRAY CURRENT TESTS ON UNDERGROUND TELEPEONE
   INSULATION LEVELS OF DC FILTER REACTORS AND RESISTORS FOR HYDC FOWER TRANSMISSION, W70-09016 ORC.
   PREDICTION OF RELIABILITY AND AVAILABILITY OF HVDC VALVE AN HVDC TERMINAL, W70-09017
   TRANSIENT OVERVOLTAGE OR A BIPOLAR HVDC OVERHEAD LINE CAUSE
   EY CC LINE FAULTS,
W70-09018
DISCHABGE (WATER)
GROUNDWATER DISCHARGE IN THE ILLINOIS BASIN AS SUGGESTED BE
TEMPERATURE ANOMALIES,
02F
DISPERSION
    WO-DIMENSIONAL DISPERSION EXPERIMENTS IN A POROUS MEDIUM,
   DISPERSION IN HOMOGENEOUS ESTUARY FLOW, W70-09217
   DISPERSION PREDICTION FROM CURRENT METERS,
DISSOLVED OXYGEN
THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN
CONCENTEATION IN THE DELAHARE RIVER,
W70-05189
05C
   RESPONSE OF DAIRY WASTE ACTIVATED SLUDGE TO EXPERIMENTAL CONDITIONS AFFECTING PR AND DISSOLVED OXYGEN CONCENTRATION, W70-09332
DISSOLVED OXYGEN CONCENTRATION
THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN
CONCENTRATION IN THE DELAWARE FIVEE,
N70-09189
05C
DISSOLVED SOLIDS
A STUDY OF THE HYDROCHEMICAL FACIES OF THE WILCOX AQUIFERS
IN HISSISSIPPI,
                                                             02K
   DISSOLVED SOLIDS-DISCHARGE RELATIONSHIPS 1. MIXING
   MODELS, W70-09311
DISTILIATION
HYDROCARBONS IN THERHAL AREAS, NORTHWESTERN WYOMING,
   W76-09108
   MANUAL CM SOLAR DISTILLATION OF SALINE WATER, W70-09244
   SUPERVISION, CONSTRUCTION AND EVALUATION OF A SEA WATER DESULPATING PROCESS PILOT PLANT, W70-09354 03A
   DISTILLATION DIGEST VOLUMES 1 AND 2. 870-09360
DIVERSICH

FRANKLIN V UNITED STATES (CONSEQUENTIAL DAMAGE FROM FEDERAL
DIKE CONSTRUCTION IN INFROVEMENT OF NAVIGATION).
W70-09080

OGE
   BERGER V OHLSON (NO ARSOLUTE RIGHT TO TOLL FREE USE CF GOVERNMENT CONTROLLED DOCK).

W70-09469

OGE
DRAINAGE
   A STODY OF REDISTRIBUTION AFTER THE FINISH OF HORIZONTAL INFILTRATION (FRENCH), W70-09304 D2G
   STUDY OF EROSION IN ROADSIDE DRAINAGE CHANNELS IN NORTH
   MILLER V MONONA COUNTY (DRAINAGE DISTRICT LIABILITY FOR NUISANCE).
DRAINAGE LISTRICTS
CROSSY V DE LAND SPECIAL DRAINAGE DIST (VALUE TO FARMLAND OF IMPROVED DRAINAGE SYSTEM).
044
   HOPKINS V UPPER SCIOTO DRAINAGE AND CONSERVANCY DIST (NO DAMAGES FOR IMPROPER MAINTENANCE OF DRAINAGE DISTRICT'S WATERWAYS).
   PALH BEACH COUNTY V SOUTH FLORIDA CONSERVANCY DIST (DRAINAGE DISTRICT'S USE OF LEVEE FOR CONSERVATION PARAMOUNT TO COUNTY'S USE AS A PUBLIC ROAD).
   BROWN V NORTH ST LUCIE RIVER DRAINAGE DIST (DUTY OF
```

SUEJECT INDEX DRA-EL

IANICHMERS TO MAINTAIN LATERALS CONNECTING TO DITCH OF LRAINAGE LISTRICT), 06E

COMM'RS OF DRAINAGE DISTRICT NO 5 V ARNOLD (JUDICIAL INTERPRETATION OF DRAINAGE STATUTE). 04A

EAY ISLAND LEAINAGE AND LEVEE DIST NO 1 V NUSSBAUM (OPERATION COSTS OF PUMPING FACILITY).

870-69155

06C

SCOTT V BED RIVER-BAYOU PIERRE LEVEE AND DRAINAGE DIST (RIGHT TO COMPENSATION FOR EXPROPRIATED LAND). W70-09487 044

MEYFEIRG LAND CC V SPENCER (DRAINAGE DISTRICT HAS NO POWER TO CONSTRUCT SEWERS UNDER AUTHORITY FOR DRAIN CONSTRUCTION). W70-09488

FAYNE V MISSOURI VALLEY DRAINAGE DIST NG 1 (CONSTRUCTION OF NEW SETTLING BASIN AS REPAIR OF OLD BASIN). 04D

MILIER W MONONA COUNTY (FRAINAGE DISTRICT LIABILITY FOR NUISANCE).

70~69493

04a

HOGUE V WONCHA-BARBISON DRAINAGE DIST (PROTECTION OF PRIVATE FROPERTY FROM FLOODING CAUSED BY DEALNAGE IMPROVEMENTS). W70-09494

DRAINAGE FFECTS

FORKINS TO UPPER SCIOTO DEAINAGE AND CONSERVANCY DIST (NO IAMAGES FOR IMPROPER MAINTENANCE OF DRAINAGE DISTRICT'S WATERWAYS).

WATERWAYS).

OGE

DBAINAGE FATTERNS (GEOLOGIC)
STREAM CROEK AS A HEASURE OF SAMPLE SOURCE UNCERTAINTY,
W70-09202 02J

USE OF TOPOLOGIC INFORMATION IN PROCESSING DATA FOR CHANNEL NETWORKS, W70-09204 07C

DRAINAGE FRACTICES

MAFFEI W BEBRIEN COUNTY (COUNTY'S LIABILITY FOR FLOOD DAMAGE
CAUSED FY NEGLIGENT MAINTENANCE OF DRAINAGE SYSTEM).

870-09429

048

DAINAGE SYSTEMS

ED OF ELUC W NORTH HEMPSTEAD (NO RIGHT TO DAMAGES FOR NATURAL FICK OF SURFACE WATERS).

#70-09055

DRAIN INSTALLATION FOR MITRATE REDUCTION,

ELECTRONIC COMPUTER PROGRAM FOR HYDRAULIC ANALYSIS OF BOX COLVER'S (BFE PROGRAM HY-3), 08A

THOMESON V CITY OF PEILADELPHIA (DAMAGE CAUSED BY CITY BAINTAINED SERAGE SYSTEM). 05g

SCOIT W RED BIVEF-BAYOU PIERRE LEVEE AND DRAINAGE DIST (BEGGHT IC COMPENSATION FOR EXPROPRIATED LAND). 970-09487

DREEGING
COOPER V CITY OF BOGALUSA (FEDERAL RESPONSIBILITY FCB
DAMAGES CAUSED BY NAVIGATION IMPROVEMENTS).
970-09486
04A

FERRENS V CITY OF MINNEAPOLIS (PUBLIC PURPOSE REQUIREMENT FOR CHANNEL INFROVEMENT) - 06E

RILLING
ON GEOLOGICAL AND TECHNOLOGICAL ASPECTS OF ORIENTED N-SIZE
CORE DIAMONE DRILLING,
W70-09028
08E

CARTIER CIL CO V DELWORTE (LESSEE OF LAND ABUTTING CREEK HAS BIGET TC CREEK ETC). 06E 06E

PRILLING EQUIFMENT
ON GROLOGICAL AND TECHNOLOGICAL ASPECTS OF OBJENIED N-SIZE
CORE DIAMENE DRILLING,
08E
070-09028

COMPLEX EQUIPMENT FOR SINKING AND DRILLING OF VERTICAL SEAFTS, 08H

DROUGET RESISTANCE
THE STABILITY OF WHEAT EMBRYO GLUTAMATE DECARBOXYLASE UNDER
CONDITIONS OF WATER STRESS,
W70-09138
02I

DEVING AN EMPIRICAL EXPRESSION FOR THE DESCRIPTION CURVE, 870-09292

DUFATION CUBYES INDIRECT METHOD FOR COMPUTING THE DURATION OF PRECIPITATION, 02B R70-09166

DYNAMIC EROGRAMMING ECONOMICS OF CANNERY WASTE TREATMENT, W70-09338 05D

EARLY ELIGHT
THE EFFECT OF SOIL MOISTORE LEVEL OF THE INCIDENCE OF EARLY
BLIGHT ON POTATO AND TOMATO PLANTS,
W70-09137
021

EARTH FRESSURE
LATERAL PRESSURES ON RIGID PERMANENT STRUCTURES,
W70-09045
08D

EASEMENTS
DUKE FOWER CO V TOMS (POWER COMPANY'S RIGHT TO FLOOD ACCOMPANIED BY DUTY TO PAY DAMAGES).
W70-09075
06E

PLORIDA BLUE RIDGE CORP V TENNESSEE ELECTRIC POWER CO (RELATIVE RIGHTS IN PROPERTY SUBJECT TO EASEMENTS). W70-09079

DANFORTH V UNITED STATES (CONDEMNATION VALUE OF EASEMENT FOR FIGOR CONTROL PURPOSES). W70-09164

IN RE CITY OF NEW YORK (RIGHTS OF OWNERS OF BEDS SUBSERVIENT TO UPLAND OWNER'S RIPARIAN RIGHTS). W70-09457

KARLSON V UNITED STATES (CONDEMNATION OF FLOWAGE EASEMENT OVER RIPARIANS'S LANDS). 06E

UNITED STATES V CHICAGE B AND Q RR (EXTENT OF JUST COMPENSATION IN CONDEMNATION PROCEEDING). W70-09482 044

ECOLOGICAL PROBLEMS
ENVIRONMENTAL QUALITY.
W70-09347

BCOLOGY NATIONAL INSTITUTE OF ECOLOGY AN INCUIRY, VOLUMES 1 AND 2. 06F

ECONOMIC EFFICIENCY
EVALUATION PROCESSES IN WATER RESOURCES PLANNING.
W70-09369
06B

ECONGMICS
THE OPTIMIZATION OF STORM-HOLDING TANKS
POLIDICS CONTROL,
W70-09181

056

ENGINEERING AND ECONOMIC EVALUATION STUDY OF REVERSE OSMOSIS, \$770-99363\$

ECOSYSTEMS
A STUDY OF THE AQUATIC ECOSYSTEMS IN TWO NATIONAL WATERFOWL REFIGES IN MISSISSIPPI, 021

EDDY VISCOSITY
NOTES ON A THEORY OF THE THERMOCLINE,
W70-09191 05B

EDUCATION
CHAPTER 3 EDUCATION AND THE ENVIRONMENT.
W70-09441 09A

EFFECTS
THE SEASONAL PERPORMANCE AND THE PATTERNS OF CHEMICAL AND
BICLOGICAL EVENTS IN SEWAGE LAGOONS,
W70-09333
05D

CONTROL MECHANISMS OPERATIVE IN A NATURAL MICROBIAL POPULATION SELECTED FOR ITS ABILITY TO DEGRADE L-LYSINE, II. EFFECTS OF PRUCTOSE AND RTBOSE IN BATCH SYSTEMS, W70-09336

CONTROL MECHANISMS OPERATIVE IN A NATURAL MICROBIAL POPULATION SELECTED FOR ITS ABILITY TO DEGRADE L-LYSINE, III. EFFECTS OF CARBOHYDRATES IN CONTINUOUS-FLOW SYSTEMS UNDER SROCK LOAD CONDITIONS, W70-09337

EVALUATION PROCESSES IN WATER RESOURCES PLANNING. W70-09369

EFFICIENCIES COMPARISON OF APPRATION EFFICIENCY UNDER PROCESS CONDITIONS, 05D 05D

EFFLUENTS
FILTRATION OF WASTE PLANT EFFLUENTS,
W70-09317
05D

AERATED LAGOONS TREAT SECONDARY EFFICIENT, 05D

THE OBIGIN AND CHARACTERISTICS OF TOXIC WASTES, WITH PARTICULAR REFERENCE TO THE METAL INDUSTRIES, W70-09340 05D

PLUCTUATION OF EFFLUENT QUALITY IN ACTIVATED SLUDGE PLANTS, W70-09504

EL SALVADOR HYDROLOGICAL ANALYSIS OF VOLCANIC TERRANE LOWER BASIN OF

```
FLE-FNV
   THE RIO GRANCE DE SAN MIGUEL, PL SALVADOR,
ELECTRIC ANALOGS

RESEARCH INTO THREE-DIMENSIONAL SEEPAGE IN JOINTED BOCK

FOUNDATIONS OF FIGH DAMS.
   CATHODIC FROTECTION OF THE BONNEVILLE POWER ADMINISTRATION'S 34.5 KV SAN JUAN ISLANDS CAFLE,
ELECTRIC DISCHARGES
IMPULSE DISCHARGE ON CONTAMINATED SURFACE,
%70-09039 08C
ELECTRIC INSUIATION
IMPULSE DISCHARGE ON CONTAMINATED SURFACE,
1870-09037 ORC
ELECTRIC ECTENTIAL CATROCTC FROTECTION OF THE BONNEVILLE POWER ADMINISTRATION'S 34.5 KV SAN JUAN ISLANDS CAPIE, W70-09013 09C
ELECTRIC FOWER - IMPACT CW THE ENVIRONMENT, W7C-09020 06B
   MAJOR ELECTRIC FOWER FACILITIES AND THE ENVIRONMENT,
   RUSSIANS PUSH MAGNETOHYDRODYNAMIC FOWER, W70-09167 08C
   BOLYOKE WATER POWER CO T AN WRITING PAPER CO (USE OF WATER FOWER BEYOND SCOPE OF GRANT). 06E
```

ELECTRIC FOWESPLANTS
FLORIDA BLUE RIDGE CORP V TENNESSEE ELECTRIC POPER CO
(RELATIVE BIGHTS IN PROPERTY SUBJECT TO FASEMENTS).

06E

BLECTRIC SEACTORS
SPACE HEATING IN URBAN ENVIRONMENTS,
W70-09192

ELECTFICAL CONDUCTANCE
APPLICATION OF ESSISTIVITY METHODS IN MINERAL AND
GROUNDWATER EXFLORATION PROGRAMS,
W7G-09407
07B

ELECTRICAL COEONAS
CALCULATION OF RADIC BOISE LEVEL FOR THE DESIGN OF AC POWER
TRANSHISSIOE LINES,
B7C-09038
08C

ELECTRICAL INSULATORS
IMPULSE DISCHARGE ON CONTAMINATED SURFACE,
W70-09039 08C

ELECTRICAL RESISTANCE
SCHE BETSCOS FOR THE DETERMINATION OF SOIL MOISTURE AND
FALANCE MEASURING,
W70-09270 07B

ELECTFICAL STUDIES
APPLICATION OF RESISTIVITY METHODS IN MINERAL AND GROUNDWATER EXPLORATION FROGRAMS, W70-09407 07B

INTERPRETATION OF GEOBLECTRICAL RESISTIVITY MEASUREMENTS FOR SCLVING BYTERGEOLOGICAL FROBLEMS, 07B

ELECTRONIC EQUIPMENT
FREDICTION OF RELIABILITY AND AVAILABILITY OF HYDO VALVE AND
EVIC TERMINAL,
W70-09017
080

EMINENT DCHAIR
IN BE EAST BIVER DRIVE (VALUATION OF SCENIC BASEMENTS IN CORDERNATION ESCREPTINGS).

UNITED STATES V SPONENBARGER (ALLEGED TAKING OF PRIVATE FFOREST WITHOUT JUST COMFERSATION VIA FLOOD CONTROL PLAN). N70-09068

EAMFORTE V UNITED STATES (COMPENSATION FOR TAKING OF PRIVATE 06E

THITTED STATES V DICKINSON (EMINEUT FORAIN BY PAISING LEVEL OF FIVES PUBSUANT TO CONSTRUCTION OF DAM).

W70-09074

06E

FIRE RAFIDS FOWER CO V MINNEAPOLIS ST P AND S S M RY (RELATIVE RIGHTS TO RIVER BED AS BETWEEN BRIDGE GWNER AND LAW CHNEE).

06E

SLIDE HOUSTAIN BEALTY CO V STATE (CONDENSATION VALUE OF a WATER BODY AND DAH). R70-09158

UEITED STATES EX REL TVA V POBELSON (CONDEHNATION VALUATION). N70-09459

KARLSON V UNITED STATES (CONDEHNATION OF PLOWAGE EASEMENT OVER RIPARIANS'S LANDS). W70-09481 UNITED STATES V CHICAGE B AND Q RR (EXTENT OF JUST COMPENSATION IN CONDEMNATION PROCEEDING). 970-09482 THOMESON W CITY OF PHILADELPHIA (DAMAGE CAUSED BY CITY NATHTHINED SEWAGE SYSTEM). 056 SCOTT V RED RIVER-BAYOU PIERRE LEVEE AND DRAINAGE TIST (RIGHT TO COMPENSATION FOR EXPROPRIATED LAND). W70-09487 EMULSIFIERS
TOXICITY STUDIES WITH AN OIL-SPILL EMULSIFIER AND IDE GREEW!
ALGA PRASINOCLADUS MARINUS,
W70-09429
05C PRELIMINARY RESULTS OF THE EXPERIMENTS ON THE TOXICITY OF OIL CCUNTERACTING AGENT (ESSO COBEXIT 7664), WITH AND WITHOUT IRAQ CRUDE OIL, FOR SELECTED MEMBERS OF MARINE EMULSION
FLEXIBILITY KEY TO DESIGN OF HACHINING PLANT'S TREATMENT PACILITIES, W70-09326 ENERGY AND HYDRAULIC TESTS ON MECHANICAL AERATION SYSTEMS, ¥70-09503 ENERGY EALANCE
DISPOSAT. OF BRINE BY SOLAR EVAPORATION FIELD EXPERIMENTS,
W70-09150
02D EHERGY EDEGET
AN ENERGY BUDGET STUDY ABOVE THE FOREST CANOPY AT HARMOT CREEK, ALBERTA, 1967, W70-09111 02D A DIUBNAL DISTRIBUTION PUNCTION FOR CALLY EVAPOPATION, ENERGY CENTERS
SPACE HEATING IN URBAN ENVIRONMENTS, W70-09192 SPACE BEATING IN URBAN ENVIRONMENTS, W70-09192 USES OF WASTE HEAT, W70-09193 ENGINEERING GEOLOGY
CROSSING THE SIERRA MADRE PAULT ZONE IN THE GLENDORA TUNNEL,
SAN GABRIEL MOUNTAINS, CALIFORNIA,
09E
09E RESERVOIR LEAKAGE IN LIMESTONE TERRAINS, 04A ENGLAND AND WALES
PLANNING OUR PUTURE WATER RESOURCES,
W70-09153 ENVIROBENT CHAPTER 2 W70-09440 INSTITUTE FOR ANALYTICAL STUDIES. ENVIRONMENT
ELECTRIC POWER - IMPACT ON THE ENVIRONMENT,
W70-09020 06B HAJOR ELECTRIC POWER FACILITIES AND THE ENVIRONMENT, 970-05048 EVALUATION PROCESSES IN WATER RESOURCES PLANNING. W70-09369 06B INTRODUCTION. 06B CHAPTER 3 W70-09441 EDUCATION AND THE ENVIRONMENT. HONITORING THE ENVIRONMENT. NATIONAL LABORATORY FOR ENVIRONMENTAL SCIENCE.

ENVIRONMENTAL EFFECTS
A SELECTED ANNOTATED BIBLIOGRAPHY OF ENVIRONMENTAL STUDIES
OF POLABD,
U70-09456 02B

ENVIRONMENTAL COALITION
CHAPTER 3 EDUCATION AND THE ENVIRONMENT.
W70-09441 09A

FEDERAL ORGANIZATION FOR BANAGING THE

06E

ENV-EVA SUBJECT INDEX

VIRONMENTAL MODITORING PROGRAM CHAPTER 4 MCNITORING THE ENVIRONMENT. W70-09442 07E

VIRONMENTAL QUALITY ENVIRONMENTAL QUALITY. W70-09347

0.5G

EVALUATION PROCESSES IN WATER RESOURCES FLANNING. #70-09369 06P

VIRONMENTAL QUALITY INDEX CHAPTER 4 MONITORING THE ENVIRONMENT. 07B

NVIRONMENTAL SANITATION ENVIRONMENTAL QUALITY. W70-09347

0.5G

THE STABILITY OF WHEAT EMERYO GLUTAMATE DECARBOXYLASE UNDER CONDITIONS OF WATER STRESS, W70-09138

FITHERMAL NEUTRCH MOISTURE METERS
NEUTRCH MOISTURE METER FOR SALINE SOILS,
N70-09268 C7B

QUATIONS
ON USING A TIME VARIABLE INFILTRATION WITH THE ISRAELSON ECORDER IBRIGATION EQUATION,
03P.

SCIUTIONS OF THE NCH-LINEAR DIFFUSION EQUATION WITH A GRAVITY TERE IN HYDEOLOGY, 970-09308

QUITABLE APPORTIONMENT
HINDERIDES V LA FLATA RIVER AND CEERT CREEK DITCH CO
(EQUITABLE APPORTIONMENT OF INTERSTATE STREAM THROUGH USE OF
INTERSTATE CONTACT).

COLOGADO V KANSAS (APPORTIONMENT OF WATER BETWEEN UPRIVER AND CORNELVER STATES). 06E

NEERASKA V WYOMING (APPORTIONMENT OF INTERSTATE WATERS UNDEFFEICE AFFROFRIATION). U6E

EQUITABLE TITLE

VANNEY SIVER DRAINAGE DIST V SPIEDEL (ASSESSMENTS ON LAND

HELD BY EQUITABLE TITLE).

W7C-C9056

FRANKLIB V UNITED STATES (CONSEQUENTIAL DAMAGE FROM FEDERAL DIKE CONSTRUCTION IN IMPROVEMENT OF NAVIGATION).

06E

T A ROSS COUST CC V TEARSLEY (GOVERNMENTAL LIABILITY FOR DAMAGES ARISING FROM IMPROVEMENT OF WAVIGATION). G6E

EFFECTS OF EFFLUENT AND INFLUENT SEEPAGE ON THE HYDRODYNAMIC FORCES ACTING ON AN IDEALIZED HONCCHESIVE SEDIMENT FARTICLE, 1870-09410

WATER PROSICE, THE FORMING OF SEDIMENT FLOW OF SHALL STREAMS IN THE CENTRAL CHERNCZEM PROVINCES AND MEASURES FOR FROZECTING FESERVOIRS FROM SILTING,

INLAND FOWER AND LIGHT CC V GRIEGER (FLCOD DAMAGE FROM NEGLIGERI DAM OFERATION).
070-09476

EBCSICH CCHTRCI
WATER EROSICH, THE FORHING OF SEDIMENT FLOW OF SHALL STREAMS
IN THE CENTRAL CHERNICZEM PROVINCES AND HEASURES FOR
FROTECTING DESERVOIRS FROM SILTING,

EROSICH COMTROL ON ECADSIDES IN TEXAS, 02J

ESCHEBICATA CCLI
INVESTIGATION ON THE CONTROL OF FILAMENTOUS BULKING,
E70-09509

ESSC CCREXIT 7664

FREITHINARY RESULTS OF THE EXPERIMENTS ON THE TOXICITY OF

CIL CCUNTERACTING AGENT (ESSC CORRIT 7664), WITH AND

NITHOUT IRAC CRUDE OIL, FOR SELECTED MEMBERS OF MARINE FIANKION, 870-09434

ESTIMATING
CAPILLARY CCWDDCTIVITY DATA ESTIMATED BY A SIMPLE METHOD, 07B
970-09277

A BOTE ON THE ESTIMATION OF THE PARAMETERS IN LOGARITHMIC STAGE-LISCHARGE RELATIONSHIPS WITH ESTIMATES OF THEIR ERROR, W70-C9374

ESTUARIES
ESTUARY ENTEANCE, UNEQUA RIVER, OREGON HYDRAULIC MODEL
INVESTIGATION,
670-09179

THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYCEN CONCENTRATION IN THE DELAWARE RIVER, W70-09149 05C

SOME EFFECTS OF FRESH-WATER INFLOW ON THE FLUSHING OF SOUTH SAN FRANCISCO BAY A PRELIMINARY REPORT, W70-09215 05G

MOVEMENT OF SEABED DRIFTERS IN THE SAN FRANCISCO BAY ESTUARY AND THE ADJACENT PACIFIC OCEAN A PRELIMINARY REPORT, W70-09216 O2L

DISPERSION IN HOMOGENEOUS ESTUARY FLOR, 02L

POLIUTION OF ESTUARIES, W70-09383

ISOPACHOUS MAPPING OF THE LOWER PATUKENT ESTUARY SEDIMENTS BY CONTINUOUS SEISMIC PROFILING TECHNIQUES, W70-09390.

ESTUARINE ENVIRONMENT HEAT WASTE, W70-09162

EUTROPHICATION
WATER QUALITY IN RELATION TO PRODUCTIVITY OF LAKE ASSTABULA
RESERVOIR IN SOUTHEASTERN NORTH DAKOTA,
5C

EFFECTIVE PHOSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE ACTIVATED SLUDGE PROCESS, W70-09186 05D

THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN CONCENTRATION IN THE DELABARE RIVER, W70-05189 05C

A STATEMENT ON PHOSPHORUS, W70-09325 05D

DETERGENTS, PHOSPHATES, AND WATER POLIUTION, W70-09388

EVALUATION EVALUATION PROCESSES IN WATER RESOURCES PLANNING. W70-09369 06B

COMPARATIVE STUDIES OF THE MOLLUSCICIDAL EFFECT OF CUPROUS CHLORIDE AND COPPER SULFATE IN IRAN, W70-09432

AN ANALYTICAL METHOD FOR EVALUATING THE SUSCEPTIBILITY OF FISH SPECIES TO AN AGRICULTURAL CHEMICAL (JAPANESE), W70-09433

EVAPORATION INFLUENCE OF EVAPORATION PROB LAKE BAIKAL ON PRECIPITATION IN THE SURROUNDING REGIONS,

DISPOSAL OF BRINE BY SQIAR EVAPORATION FIELD EXPERIMENTS, W70-69150

A DIURNAL DISTRIBUTION FUNCTION FOR DAILY EVAPORATION, W70-09205

MONTHLY MEAN SURFACE TEMPERATURES FOR LAKE CHTABIC AS DETERMINED BY APPIAL SURVEY,

THE ROLE OF VEGETATION IN SOIL WATER PROBLEMS, W70-09262 021

WATER TRANSPORT IN SOILS BY EVAPORATION AND INFILTRATION, W70-09276

SOIL TEMPERATURE AND WATER CONTENT CHANGES DURING AS INPLUENCED BY CRACKS A LABORATORY FIFERIMENT, 970-09379

MAP OF EVAPORATION FROM SMALL RESERVOIRS OF THE CENTRAL CHERNOZEM PROVINCES, M70-09413

EVAPORATION CONTROL
ENERGY RELATIONSHIPS IN THE DESIGN OF FLOATING COVERS FOR
EVAPORATION REDUCTION,

EVAPORATION PANS
DISPOSAL OF BRINE BY SOLAR EVAPORATION FIELD EXPERIMENTS,
C2D #70-09150

EVAPOTRANSPIRATION
AN ENERGY BUDGET STUDY ABOVE THE FOREST CAMOPY AT MARMOT
CREEK, ALBERTA, 1967,
W70-09111

WATER USE BY SALT CEDAR, W70-09113

THE ROLE OF VEGETATION IN SOIL WATER PROBLEMS, W70-09262

EVAPOTRANSPIRATION CONTROL
TRANSPIRATION OF PONDEROSA PINE AND DOUGLAS FIR AFTER
TREATMENT WITH PRENYLHERCURIC ACETATE
W70-09207
O3B

```
EXCFFI OUTLIEF FOR GAGED PENNSYLVANIA STREAMS,
  ¥70-09420
```

EXCLUSIVE HIGHTS
CARTER CIL CC V DELWORTH (LESSFE OF LAND ABUTTING CREEK HAS HIGHT IC CREEK PED). 06E

EXFANSIVE SOILS
SOIL TEMPERATURE AND WATER CONTENT CHANGES DURING DRYING AS INFLUENCED BY CRACKS A LABORATORY EXPERIMENT,

EXFIGRATION A GEOCHERICAL DRAINAGE SURVEY IN CENTRAL ECUADOR, W70-09352 02K

EINING AND GROUNDWATER GEOPHYSICS/1967. W70-09392 07B

GEOPHYSICS IN THE U.S.S.R., W70-09393 07E

GEOPHYSICAL PROSPECTING AND RESEARCH ON UNDERGROUND WATER

CEOFFYSICS IN UNITED NATIONS FROJECTS, 870-09397 07B

APPLIED GEOFRYSICS IN THE NATURAL ENVIRONMENT RESEARCH COUNCIL IN GREAT ERITAIN, W70-09398 07B

EXTRA HIGH VOLTAGE
1969 HVDC STRAY CURRENT TESTS ON UNDERGROUND TELEPHONE
CAPIES,
W70-09015 08C

INSULATION LEVELS OF DC FILTER REACTORS AND RESISTORS FOR BYDC FOWER TRANSMISSION, W70-09016 08C

PREFICTION OF RELIABILITY AND AVAILABILITY OF HVDC VALVE AND EVIC TEFEINAL, N7G-09017

FACIES A STUDY OF THE BYDROCHEMICAL FACIES OF THE WILCOX AQUIFERS IN BISSISSIEPT, E70-09095

CHEMICAL COMPOSITION OF PRECIPITATION IN REGIONS OF THE SCUIET UNION, W70-09133 02B

STRONTION 90 CONCENTRATIONS IN SURFACE AIR VERSUS ATIABLIC CCIAN FROM 1966 TO 1969, W70-09229 02B NORTH AMERICA

IFAD IN A SCHURPAN ENVIRONMENT, W7C-09251 02K

FAILOHING

EFFECT OF SCIL FROFILE TYPE AND FERTILIZER ON MOISTURE USE

IY MEEAT GROWN ON FALLOW OR STUBBLE LAND,

W70-09139

03F

FABR USES OF WASTE HEAT USES OF WASTE HEAT, £70-09193

PAGE WASTES
AGRICULTURAL WASTES AND THE ENVIRONMENT,
05B

PAULTS (ELECTRICAL)
TRANSIENT OVERVOLTAGE ON A BIPCLAR HYDC OVERHEAD LINE CAUSED FY DC 11ME FAULTS,
W70-09018
08C

FAULTS (GECICGY)
CROSSING THE SIERRA HADRE FAULT ZONE IN THE GLENDORA TUNNEL,
SAN GABEJEL MOUNTAINS, CALIFORNIA,
W70-09027
08E

LEGAL GOVERNMENT VARNEY BIVER DRAINAGE DIST V SPIEDEL (ASSESSMENTS ON LAND LEIC EV EQUITABLE TITLE).
670-09058 06E

JAMES V DRAVO CONTRACTING CO (STATE'S RIGHT TO TAX FEDERAL GOVERNMENT'S CONTRACTORS).

UNITED STATES V ALASKA (BELATIVE RIGHTS IN SUBMERGED LAND). W70-09242

FFTERSON V UNITED STATES (PUPLIC WORK INCLUDES FLOOD CONTROL AND IMPROVEMENTS TO NAVIATION).

CCOFFE W CITY OF BOGALUSA (FEDERAL RESPONSIBILITY FOR LAMAGES CAUSEL BY NAVIGATION IMPROVEMENTS). R70-09466

PETERAL JUBISTICTION

EAMFORTE V UNITED STATES (CONDENSATION VALUE OF EASEMENT POR

FLCOT CONTROL PURPOSES) . W70-09164 BROOKS V UNITED STATES (JURISDICTION OF FEDERAL COURT TO DETERMINE WATER HIGHTS IN INTERSTATE RIVER). W70-09470

068

FEDERAL RECLAMATION LAW ICKES V POX (INCREASED WATER RATES IMECSED CONTRARY TO LA W70-09667 06E

ICKES V FOX (PROTECTION OF PRIVATE APPROPRIATION RIGHTS I PEDERAL RECLAMATION PROJECT). W70-09479 QGE

PEED LCT WASTES
TREATMENT OF DAIRY MANUFE BY LAGOONING,
W70-09335
05D

FERTILIZERS
DIGESTED SLUDGE DISPOSAL ON CROP LAND,
W70-09328
05D

FIELD CAPACITY
THE NATURE OF THE MINIMAL WATER RETENTIVE CAPACITY, W70-09302 02G

THVESTIGATION ON THE CONTROL OF FILAMENTOUS BULKING, $\ensuremath{\text{W}}70-09569$

FILTERING SYSTEM
RADICTRACER STUDIES ON RAPID SAND FILTRATION,
W70-09091 05P

FILTERS
INSULATION LEVELS OF DC FILTER PRACTORS AND RESISTORS FOR
HVDC FOVER TRANSHISSION,
08C #70-09016

FILTRATION FILTHATION OF WASTE PLANT EFFLUENTS,

ON THE ADDRESSION OF FORE WATER IN FINNISH ARGILLACEOUS SELIMENTS OF DIFFERENT AGE, 870-05195

THE TEMPERATURE SELECTION OF SHALL HYPOPHYSECTOMIZED GOLDFISH, (CARASSIUS AURATUS L.), W70-09151 C5C

ENVIRONMENTAL CHANGES PRODUCED BY COLE-WATER OUTLETS FROM THEFF AFRANSAS RESERVOIRS, \$70-09344 C6G

FISH BEHAVIOR TEMPERATURE, REPRODUCTION AND BEHAVIOR, W70-C9170 05C

EFFECIS OF SUBLETHAL DDT ON A SIMPLE BEPLEX IN BROCK TROUT, W70-09428

FISH FCCT OFGANISMS EFFECTS OF DIQUAT ON BLUEGILLS AND THEIR FOOD ORGANISMS, W70-09431 OSC

FISH PHYSIOLOGY
THE TEMPERATURE SELECTION OF SHALL HYPOPHYSECTOMIZED GOLDFISH, (CARASSIUS AURATUS L.), W70-09151 05C

EFFECTS OF SUBLETHAL DDT ON A SIMPLE REFLEX IN ERCCK TROUT, N70-09428

AMMONIA TOXICITY IN SELECTED FISHES, W70-09430

EFFECT OF TEMPERATURE SHOCK ON THE TEMPERATURE PESISTANCE OB FOLKILOTHERM AQUATIC ANIMALS. EXPERIMENTS ON THE FROBLEM OF HEAT AND COLD-HARDENING IN ANIMALS (GERMAN), W70-09436

FISH REPRODUCTION
TEMPERATURE, REPRODUCTION AND BEHAVIOR,
W70-09170 05C

FISHING

NE-BO-SHONE ASS'N, INC V HOGARTH (PUBLIC FISHING RIGHTS IN NAVIGABLE RIVERS).

NAVIGABLE RIVERS).

06E

PLASH DISTILLATION
A METHOD FOR THE EVALUATION OF THE SISTEM AND COST
EFFECTIVENESS OF LARGE SEA WATER DISTILLATION PLANTS.
03A

PLASHOVER
IMPOLSE DISCHARGE ON CONTAHINATED SURFACE,
W70-09039
08C

FLEXIBILITY KEY TO DESIGN OF MACHINING PLANT'S TREATMENT

POLYMER PLUS MAGNETIC FIELD USED TO TREAT PARAMAGNETIC SLURBIES,

€70-09316 05D

EALY V NEW YORK (CAMAGES TO CROFS FROM FARGE CANAL CONSTRUCTION).

EABCOCK V MISSISSIPFI RIVER POWER CO (INJURY TO LAND VIA DAM CONSTRUCTION).

#70-09078

MCAILISTER V SICAN (FIOCDING OF PROPERTY DUE TO DAM CCNSTFUCTION) . N7C-09085

TROUT BEFORE CC V WILLOW FIVER POWER CO (LIABILITY FOR DAM FAILURE CUFING UNPRECEDENTED FLCOD). W7C-09C89 06E

DALY V STATE (FLOOD DAMAGES CAUSED BY CANAL CONSTRUCTION). 670-09143

MCHAWK CARPET MILLS, INC V NEW YORK (DAMAGES FROM FICOD AND

FICOD FIAIN INFORMATION, COTTONWOOD CREEK, GUTHRIE, CKIAHOMA.

FICCD FIAIN INFOFMATION, SANTA CLARA RIVER, VENTURA COUNTY,

FICCD FIAIN INFCEMATION, HETROPOLITAN ATLANTA GEORGIA, UTOY CREEKS, NORTE AND SOUTH UTOY CREEKS. W70-09222 04a

FICCD OF AUGUST 1969 IN VIRGINIA,

FLOOD FIAIN INFORMATION, ALLEGHENY RIVER AND FIVEMILE CREEK, ALLEGANY, NEW YCEK. 04A

FICCD FIAIN INFCRMATION, COYOTE CREEK, SAN PRANCISCO BAY TO ANDERSON FESERVOIR, SANTA CLARA COUNTY, CALIFORNIA. 870-09365

HCHANK CARPET BILLS, INC V STATE (FLOODING CAUSED BY STATE'S NEGLICENCE IN CANAL CONSTRUCTION). W70-0945E

GOODMAN V UNITED STATES (PEDERAL GOVERNMENT'S LIABILITY FOR FLOCD CAMAGE). W70-09473

INLAND FOWER AND LIGHT CO V GRIEGER (FLGOD DAMAGE FROM NEGLICENT DAM CFERATION). 04A

BAFFEI V BEFRIEN CCUNTY (COUNTY'S LIABILITY FOR FLCCD DAMAGE CAUSED BY NEGLIGENT MAINTENANCE OF DRAINAGE SYSTEM). 870-09492

TOWN OF WAUSAUKEE V LAUERMAN (LIABILITY FOR FLOOD DAMAGES). W70-09455

FICCO IBRIGATION
HYDRAULIC DESIGN FOR CHECK METHOD OF IRRIGATION,
870-09136
03F

FICOD FLAIN ZONING FIGOD CANAGE FREVENTION. W70-09364

FICCD FECTECTION
FLOOD PLAIN MANAGEMENT - IOWA'S EXPERIENCE.
570-09253
Off

FIOOD DAMAGE PREVENTION. W70-09364

CEPERATING FORCES ON SECTOR GATES UNDER REVERSE HEADS HYDRAULIC MCDEI INVESTIGATION,

FICCDING GOODAN V UNITED STATES (FEDERAL GOVERNMENT'S LIABILITY FOR FICCE DAPAGE). 04A 970-09473

ECGUE V WONCHA-HARRISON DRAINAGE DIST (PROTECTION OF PRIVATE EFOFEHTY FFCM FICCOING CAUSED BY DRAINAGE IMPROVEMENTS). 970-09494

FICCES

EFFECTS OF FOREST CLEAR-FELLING ON THE STORM HYDROGRAPH,

03B

070-09117

WATER AS AN URBAN RESOURCE AND NUISANCE, W70-09129 04C

FLOOD FIAIN INFORMATION, COTTONWOOD CREEK, GUTHRIE, 04A

FLOOD FLAIM INFORMATION, SANTA CLARA RIVER, VENTURA COUNTY, CALIFORNIA. 970-09221

FLOOD FLAIN INFORMATION, METROPOLITAN ATLANTA GEORGIA, UTOY CREEK, NORTH AND SOUTH UTOY CREEKS, W70-09222

FLCOD FIAIN INFORMATION, ALLEGHENY RIVER AND FIVEHILE CREEK, ALLEGANY, NEW YORK. W70-09252 04A

FLOOD PLAIN MAPPING BY THE U. S. GEOLOGICAL SURVEY, W70-09255

PLOOD PIAIN INFORMATION, COYOTE CREEK, SAN FRANCISCO BAY TO ANTERSON RESERVOIR, SANTA CLARA COUNTY, CALIFORNIA. W70-09365

MILLER W MONONA COUNTY (DRAINAGE DISTRICT LIABILITY FOR NUISANCE).
W70-09493

PLOODWAYS
UNITED STATES V SPONENBARGER (ALLEGED TAKING OF PRIVATE
PROPERTY WITHOUT JUST COMPENSATION VIA PLOOD CONTROL PLAN).
W70-09068
06E

UNITED STATES V CHICAGE B AND Q BE (EXTENT OF JUST COMPENSATION IN CONDEMNATION PROCEEDING). #70-09482 04a

PLORIDA
PALM BEACH COUNTY V SOUTH PLORIDA CONSERVANCY DIST (DRAINAGE
DISTRICT'S USE OF LEVEE FOR CONSERVATION PARAMOUNT TO
COUNTY'S USE AS A PUBLIC ROAD).

BROWN W NORTH ST LUCIE RIVER DRAINAGE DIST (DUTY OF LANDCHWERS TO HAINTAIN LATERALS CONNECTING TO DITCH OF DRAINAGE DISTRICT).

06E

BLISS W KINSEY (EXTENSION OF BOUNDARY LINES FROM MEANDER LINE TO SBORE LINE). W70-09343

GIBSON V CITY OF TAMPA (POLLUTION OF CYSTER BEDS BY UNTREATED MUNICIPAL SEWAGE). 05B

FIOW OF ENTRAINED AIR IN CENTRIFUGAL FUMPS, W70-09023 08C

THE FHYSICS OF GLACIERS, W70-09412 020

FLOW ESTIMATES
AN EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM DESIGN, W70-09185

FLOW MEASUREMENT COLOR-VELOCITY METHOD IN MEASURING DISCHARGE, W70-C9449 07B

RESEARCH INTO THREE-DIMENSIONAL SEEPAGE IN JOINTED BOCK FOUNDATIONS OF HIGH DAMS. 04A

PLOW BATES
ON USING A TIME VARIABLE INFILTRATION WITH THE ISRAELSON ECODED IRRIGATION EQUATION,
W70-09141
03p

COLOR-VELOCITY METHOD IN MEASURING DISCHARGE,

FLUCTUATIONS OF EFFLUENT QUALITY IN ACTIVATED SLUDGE PLANTS, #70-05504

FLUMES CALIBRATION OF WALNUT GULCH SUPERCRITICAL FLUMES, $$70\!-\!09218$$

FLUORESCENT TRACERS
USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING, W70-09029
07B

FLUORCHETRY
COLOR-VELOCITY METHOD IN MEASURING DISCHARGE,
W70-09449
07B

FLY ASH UTILIZATION CLIMBING STEADILY. 08G

FORAGE GRASSES
FORAGE CROP IRRIGATION WITH OXIDATION POND EFFLUENT,
W70-09423
O5D

FORECASTING.
METHODS OF COMPUTING MAXIMUM SOIL FREEZING DEFTH,

POREST MANAGEMENT

EPPECTS OF FOREST CLEAR-PELLING ON THE STORM HYDROGRAPH,

#70-09117

03B

PCE-GRA	SUBJ
TRANSPIRATION OF PONDEROSA FINE AND D	OUGLAS FIR AFTER
TREATMENT WITH PHENYLHERCURIC ACETATE W70-09207	"03В
PCBESTS AN ENERGY BUDGET STUCY ABOVE THE PCRE	ST CANOPY AT MARHOT
CBEEK, ALBERTA, 1967, 870-09111	020
PCSSORIAL ANIMALS BEART RATE AND CHANGES IN BODY FLUIDS	IN AESTIVATING TOADS
FROM XEBIC BABITATS, 570-09148	021
FCUNDATIONS FOUNDATION SETTLEMENT AND GROUND REAC	TION CALCULATIONS USING
A DIGITAL CCHPUTEE, W70-09036	08D
PRIE SUBFACE TURBULENCE BEASUREMENTS NEAR THE PREE	SURPACE OF AN OPEN
CHANNEL FLOW, E70-C92CE	028
FREE SURFACES FINITE ELEMENT METHOD OF ANALYZING ST	BACY SEEPAGE WITH A
FREE SUFFACE, W70-09198	0 2G
FREEZING	
CHEMICAL COMPOSITION OF THE ICE OF CT 870-09097	KAZNENSKIY BESERVOIR, O2K
AN ANALYSIS OF ICE LENS FORMATION, N70-09114	02C
FREEZING AND THAWING EPPECTS ON DRAIN	AGE,
W70-C53E0	02 G
PRISH WATER WATER-LEVEL AND WATER-QUALITY TRENDS	IN AQUIPERS ALONG THE
PISSISSIFFI GULF COAST, 1970, B70-09223	02F
FRICTION FACTORS ABOUT THE ROUGHNESS FROBLEM IN FIFES N70-09011	ANC TUNNELS, 08B
FRCST BETHCDS OF COMPUTING MAXIMUM SOIL FRE	
N70-09104 AN ANALYSIS OF ICE LENS FORMATION,	02C
W70-09114	02C
HEASUREMENT OF THE THERMAL CONDUCTIVE TRABSIEST HCT-RIBE TECHNIQUE,	
W70-09233	02C
FREEZING AND THANDES EFFECTS ON DRAIN. W70-09380	AGE, 02G
FECST BEAVING AMALYSIS OF ICE LINS FORMATION,	
W70-09114	02C
FREZEN GROUND PRASUREMENT OF THE THERMAL CONCUCTIVE THANSIENT ECT-NIRE TECHNIQUE,	TY OF FROST BY A
W70-09233	02C
PECZEN SOILS PETECDS OF CONFUTING MAXIMUM SOIL PRE: N70-09104	EZING DEPTH,
FREEZING AND THANING EFFECTS ON DRAIN.	
PUTURE PLANNING (FROJECTED)	020
FIANNING OUF FUTURE NATER RESOURCES, W70-09153	06B
GATES	
OPERATING PERCES ON SECTOR GATES UNDER HYDRAULIC MEDEL INVESTIGATION, W70-09177	e beverse heads
GAUSSIAN EFFECT	
TOREULERY DIFFUSION IN A STARLY STRAT	IFIED SHEAR LAYER, 00B
GEIS EQUIVATENCE OF ANOHALOUS WATER AND SIS 870-09125	LICIC ACID SOLUTIONS,
GENERATORS	
EUSSIAMS PUSE HAGNETOHYDRODYNABIC FOW. 870-09167	08C
GECCHEMISTRY A GEOCHEMICAL DRAINAGE SURVEY IN CENT.	RAL ECUADOR.
W70-09352	02K
GECHORPHOLOGY STREAM CROES AS A MEASURE OF SAMPLE SO \$70-09202	OURCE UNCERTAINTY,

USE OF TOPOLOGIC INFORMATION IN PROCESSING DATA FOR CHANNEL

97C

```
HOPPHOLOGY OF GULLIES IN THE COLORADO ROCKY HOUNTAINS,
GEOPHYSICS
HINING AND GROUNDWATER GEOPHYSICS/1967.
W70-09392
   GEOPHYSICS IN PROSPECTING AND EXPLORATION FOR MINEFAL
   DEFOSITS IN THE U.S.S.R.,
W70-09393
   GEOPHYSICAL PROSPECTING AND RESEARCH ON UNDERGROUND WATER
   GEOPHYSICAL STUDIES IN PERMAPROST REGIONS IN THE U.S.S.R...
   GEOPHYSICS IN UNITED NATIONS PROJECTS, W70-09397 078
   APPLIED GEOPHYSICS IN THE NATURAL ENVIRONMENT RESEARCH COUNCIL IN GREAT BRITAIN,
    W70-09398
   GEOPHISICAL PROSPECTING FOR GROUNDWATER IN THE SOVIET UNION N70-09401
   INTEGRATION OF GEOPHYSICAL METHODS FOR GROUNDWATER EXPLICATION IN THE PRAIRIE FROVINCES, CANADA, W70-09403
   INTEGRATION OF GEOPHYSICS AND HYDROGECLOGY IN THE SOLUTION I
OF RECIONAL GROUNDWATER PROBLEMS,
07B
   THE ROLE OF GEOPHYSICS IN THE DEVELOPMENT OF THE WORLD'S GROUNDWATER RESOURCES,
    W70-05405
   APPLICATION OF RESISTIVITY METHODS IN MINERAL AND GROUNDWATER EXPLORATION PROGRAMS, W70~09407 07B
   THE USE OF GRAVINETER HEASUREMENTS IN HINING AND GROUNDWATE EXPLORATION,
    W70-09408
GEORGIA BLUE RIDGE CORP V TENNESSEE ELECTRIC FORER CO (RELATIVE RIGHTS IN PROPERTY SUBJECT TO BASEMENTS).
   FLOOD FIAIN INFORMATION, BETROPOLITAN ATLANTA GEORGIA, UTOI 1
CREEK, NORTH AND SOUTH UTCY CREEKS.
W70-09222 04A
GEOTHERNAL STUDIES
BUCKANT FLUMES AND THERNALS,
W70-09168
   GROUNDWATER DISCHARGE IN THE ILLINGIS BASIN AS SUGGESTED BY TEMPERATURE ANOMALIES,
   W70-09201
   FACTORS AFFECTING SEED GERHINATION UNDER SOIL MOISTURE
STRESS,
W70-09135
GLACIAL DEIFT
PUMPING TESTS AND HYDROGEOLOGICAL INVESTIGATIONS OF AN
ARTESIAN AQUIPER NEAR HORSENS, DEMHARK,
W70-09227
O2F
   THE FHISICS OF GLACIERS, W70-09412
                                                            0.2C
GLUTAMATE DECARBOLYLASE
THE STABILITY OF WHEAT EMBRYO GLUTABATE DECARBOLYLASE UNDER
CONDITIONS OF WATER STRESS,
W70-09138
021
GLYCOPHTIES

EFFECT OF VARIATIONS IN SUBSTRATE SALINITY ON THE BATER
BALANCE AND IONIC COMPOSITION OF BEAM LEAVES,
W70-09144
   HINERAL METABOLISM OF HALOPHYTES,
GOVERNMENTAL IMMUNITY
GOODBAN V UNITED STATES (FEDERAL GOVERNMENT'S LIABILITY POR
FLOOD DAMAGE).
W70-09473
ONA
GOVERNMENTS
ENVIRONBENTAL QUALITY.
#70-09347
GRADIENT PROJECTION HETHOD
OPTIBIZATION OF WATER RESOURCES SYSTEMS BY THE GRADIENT
PROJECTION AND THE CONJUGATE GRADIENT HETHODS,
U70-09092
06a
GRAVITY STUDIES
ESTIMATING STORAGE CAPACITY IN DEEP ALLUVIUM BY GRAVITY—
SEISMIC METHODS,
W70-09373
02F
```

THE DSE OF SEISMIC REFRACTION AND GRAVITY METHODS IN EXPRESSIONS, W70-09399 07E THE USE OF GRAVIMETER MEASUREMENTS IN MINING AND GROUNDWATER EXELCRATION, W70-09408 07B REAT BRITAIN
FRITISH WATER POLLUTION CONTROL,
N7C-09041 REEN AIGAE
TOXICITY STUDIES WITH AN OIL-SPILL EMULSIFIER AND THE GREEN
ALGA PRASINCCLADUS HARINUS,
\$70-09429
05C REEN-TAILED TOWHEES

MATER ECONOBY OF THE GREEN-TAILED TOWHEE (CHLORURA
CHICRURA),
N70-09149

021 BIT REMOVAL
CEARACTERISTICS OF WASTEWATER AT DELHI,
W70-09327
05D ECUNE CUBRENTS
1969 BVDC STRAY CURRENT TESTS ON UNDERGREUND TELEPHONE
CABLES, RCUNCHATER
A STUDY OF THE HYDROCHEMICAL FACIES OF THE WILCOX AQUIFERS
1B HISSISSIFFI,
W70-09095
02R RETHED FOR COMPUTING GROUNDWATER LEVEL FLUCTUATIONS, 67C-C51C3 02F SUMMARY OF GROUNDWATER OCCURRENCE IN CALIFORNIA, 870-09214 02F WATER-IFYEL AND WATER-CUALITY TRENDS IN AQUIFERS ALCEG THE EISSISSIFFI GUIF COASI, 1970, W70-09223 C2F COMMON EERCES IN DEVELOPING A GROUNDWATER AQUIFER, 670-09225 DRAIN INSTALLATION FOR NITRATE REDUCTION, BECONNAISSANCE OF THE GROUNDWATER RESOURCES OF THE MISSOURI BIVER ALLOVIUM BETWEEN MIAMI AND KANSAS CITY, MISSOURI, W70-09249 02F GROUNDWATER BASIC DATA, PART 2 OF GEOLOGY AND GECUNEWATER RESCURCES OF MERCER AND CLIVER COUNTIES, NORTH DAKOTA, W70-09367 EINIEG AND GROUNDWATER GEOPHYSICS/1967. N70-09392

FIECTEOBAGNETIC AFRIAL SURVEY OF A FRESH WATER-SALT WATER CONTACT IN THE RHONE CELTA (FRENCH), 07B

GEOFETSICS IN UNITED NATIONS FROJECTS, N70-09397 07B

THE USE OF SEISHIC FEFRACTION AND GRAVITY METHODS IN BYDROGEOICGICAL INVESTIGATIONS, W70-09399 07B

GEOFHSICAL PROSPECTING FOR GECUNDWATER IN THE SOVIET UNION, 870-05401

A REVIEW OF SOME PROBLEMS OF SEISHIC PROSPECTING FOR GECUNDWATER IN SURFICIAL DEPOSITS, 870-09402 07B

INTEGRATION OF GEOPHYSICAL METHODS FOR GROUNDWATER EXPLORATION IN THE PRAIRIE PROVINCES, CANADA, 970-09403

THE ROLF OF GROPHYSICS IN THE DEVELOPMENT OF THE WORLD'S GROUNDWATER RESCURCES,

SEISHIC METHODS IN MINING AND GROUNDWATER EXFLORATION, 670-09406

APPLICATION OF RESISTIVITY METHODS IN MINERAL AND GROUNDWATER EXFLORATION PROGRAMS, W70-09407

THE USE OF GRAVIMETER MEASUREMENTS IN MINING AND GROUNDWATER EXPLORATION, N70-09408

INTERFRETATION OF GEOELECTRICAL RESISTIVITY MEASUREMENTS FOR SCIVING HYDROGEOLOGICAL FROBLES, 07B N70-05409

GROUNDWATER RECORDS OF SOUTH CAROLINA - 1966, W70-09411

NITRATE VARIATION IN GROUNDWATER, W70-09425

05A

GROUNDWATER BASINS
HYDROLGGY OF THE UPPER MALAD RIVER BASIN, SOUTHEASTERN
IDAHC,
W70-09132
02E

GROUNDWATER MOVEMENT
NUMBRICAL MODELING OF UNSATURATED GROUNDWATER FLOW AND
COMPARISON OF THE MODEL TO A FIELD EXPERIMENT,
W70-09107

TWO-DIMENSIONAL DISPERSION EXPERIMENTS IN A POROUS MEDIUM, w70 -- 09123

DIGITAL ANALYSIS OF AREAL FLOW IN MULTIAQUIFER GROUNDWATER SYSTEMS A QUASI THREE-DIMENSIONAL MODEL, W70-09197 02F

FINITE ELEMENT METHOD OF ANALYZING STEADY SEEPAGE WITH A
PREE SURFACE,

0.26

A HOVING BOUNDARY HODEL OF A ONE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIENT POROUS FLOW SYSTEM, #70-0919 026

FINGER IMBIBITION IN ARTIFICIAL REPLEBISHMENT OF GECUNDWATER THROUGH CRACKED POROUS MEDIUM, W70-092C0 02P

GROUNDWATER DISCHARGE IN THE ILLINOIS BASIN AS SUGGESTED BY TEMPERATURE ANOMALIES, W70-09201 02F

ELECTROLYTIC MODEL STUDY FOR COLLECTOR WELLS UNDER RIVER BEDS. W70-09210 02F

AQUIFER SIMULATION ON SLOW TIME RESISTANCE-CAFACITANCE RETRORKS, 02F 02F

GROUNDWATER VELOCITY PARTITION,
W70-09227

THE THREE-PHASE DOMAIN IN HYDROLOGY, W70-09260 02F

VALIDITY COMDITIONS OF THE POINT DILUTION METHOD, W70-09284 02F

DETERMINATION OF THE VELOCITY AND DIRECTION OF GROUNDWATER FLOW BY RADIOISOTOPES, W70-09386

GROUNDWATER POLLUTION
A STUTY OF FARM WASTE, FARM ANIMAL WASTE CHARACTERIZATION,
HANDLING, UTILIZATION,
W70-09426

GULLIES MORPHOLOGY OF GULLIES IN THE COLOBADO ROCKY MOUNTAINS, W70-09372 04D

GULLY EROSION HORPHOLOGY OF GULLIES IN THE COLORADO ROCKY HOUNTAINS, $040\,$ $040\,$

GUMBEL FAFER
FLOOD SERIES FOR GAGED PENESYLVANIA STREAMS, W70-09420 02E

RALOFBYIES

EFFECT OF VARIATIONS IN SUBSTRATE SALINITY ON THE WATER

BALANCE AND IONIC COMPOSITION OF BEAN LEAVES,

W70-09144

OZI

MINERAL METABOLISM OF HALCPHYTES, W70+09147 021

HARBORS
USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING, W70-09029
07B

ERIE LACKAWANNA RY V SIILS (SUNKEN VESSEL OBSTRUCTING DOCKS AS TEESPASS). 06E

HEART BATE
PHYSIOLOGICAL RESPONSES TO TEMPERATURE AND DESICCATION IN
THE ENDENIC NEW HEXICO PLETRODONTIDS, PLETRODON NECHEXICANUS
AND AMERICAN AND AMERICAN OPEN AND AMERICAN OPEN AND AMERICAN OPEN AND AMERICAN OPEN AND A

HEAT BUDGET
THERMAL ENERGY CONSERVATION AND SEQUENTIAL BIOLOGICAL
PROCESSING APPLIED TO SEWAGE LAGOON DESIGN,
N70-09334

HEAT EXCHANGE COEFFICIENT
A STUEY OF HEAT TRANSFER COEFFICIENTS IN THE LOWEST 400
HETEES OF THE ATMOSPHERE,
W70-09156
02B

HEAT EXCHANGERS
INTERBAL CATHODIC PROTECTION OF WATER COOLED PLANT, W70-09014 08C

HEA-HYS HERT FICE
A STUDY OF BEAT TRANSFER COEFFICIENTS IN THE LOWEST 400
METERS OF THE ATMOSFBERF,
C2B NOTES ON A THEORY OF THE THERMOCLINE, 670-09191 058 HEAT RESISTANCE
EFFECT OF TEMPERATURE AND SALINITY ON THE HEAT TOLERANCE IN
THE HERMIT CRAB, DIOGENES BICRISTIMANUS,
050 EFFECT OF TEMPERATURE SHOCK ON THE TEMPFFATURE RESISTANCE OF FCIRILOTHERM ACQUATIC ANIMALS. EXPERIMENTS ON THE PROBLEM OF EFAT AND COLD-HARDENING IN ANIMALS (GRMAN), W70-09426. HEAT TRANSFER
A STUDY OF HEAT TRANSFER COEFFICIENTS IN THE LOWEST 400
HITTER CF THE ATMOSFHERE,
W70-09156
02B HEATED WATER FEAT WASTE, \$70-09162 058 HEATING
SPACE HEATING IN URBAN ENVIRONMENTS,
#70-09192 USES OF WASTE BEAT, \$70-09193 HEAVY METALS
LEAD IN A SUBUREAN ENVIRONMENT,
W70-C9251 028 BELATION FETWEEN THE "ITAL-ITAL" DISEASE AND THE POLLUTION OF SIVER WATER BY CALMIUM FROM A MINE, 05C HEFFICIDES
TOXICITY OF SELECTED HERBICILES TO BLUEGILL SUNFISH HICE VOLTAGE FRELIABILITY AND AVAILABILITY OF HVDC VALVE AND FVIC TERMINAL, HIGH WATEE MARK
CITY OF NEW YORK V WILSON AND CO (EJECTMENT ACTION BY CITY
SPEKING ECSSESSION OF FILLEL LANDS CHIGHNALLY BELOW THE HIGH
WATEF MARK OF RIVER).

06E HISTORIC FLOOI FLOOD OF AUGUST 1969 IN VIRGINIA, N70-09234 02E HCEIZCNTAL ASIMFTOTE
FLOOD SERIES FOR GAGED PENNSYLVANIA STREAMS,
W70-09420 02E HCFIZCHTAL TEMPERATURE GRADIENT
THE TEMPERATURE SELECTION OF SMALL HYPOPHYSECTOMIZED CCLDFISH, (CARASSIUS AURATUS L.),
W70-09151 05C HUEIDITY
A CONTESEUTION TOWARDS THE REDUCTION OF ICE FOG CAUSED BY
FUHID STACK GASES AT ALASKAN FOWER STATIONS,
N70-09172
056 HUBRICANES
FICCD OF AUGUST 1969 IN VIRGINIA,
W70-09234 HYDRAULIC CONDUCTIVITY

EFFECTS OF SALTS AND ORGANIC MATERIALS ON THE HYDRAULIC CONDUCTIVITY OF THE SOILS,

W70-09290

0 2G INFILTRATION BATE AS RELATED TO HYDRAULIC CONDUCTIVITY, BUISTONE DEFICIT AND OTHER SCIL PROPERTIES, W70-09300 AN APPROXIMATE METHOD FOR DETERMINING THE HYDRAULIC CONDUCTIVITY FUNCTION OF UNSATURATED SOIL, W70-05342 02G THE EFFECT OF TEMPERATURE ON WATER FLOW IN SOILS, 670-09345 HIDRAULIC DESIGN
BYDRAULIC DISIGN FOR CHECK METHOD OF IRRIGATION,
W70-09136
03F AN EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM LESIGN, N70-05165 HYLHAULIC MODELS
FIUNE STUDIES OF THE SEDIMENT TRANSFER COEFFICIENT,
570-09119 02J

OFFRATING FORCES ON SECTOR GATES UNDER REVERSE HEADS HIPPAULIC MCDEL INVESTIGATION, W70-09177 08B

WAVE ACTION AND BREAKWATER LOCATION, VERBILION HAREOR, OHH HYDRAULIC MODEL INVESTIGATION, W70-09178 ESTUARY ENTRANCE, UNPOUR SIVER, OBEGON SYDRAULIC MODEL INVESTIGATION, STILLWAY AND OUTLET WORKS, ROWLESBURG DAM, CHEAT BIVER, WE VIRGINIA HYDRAULIC MODEL INVESTIGATION, W70-09180 EFFECTS OF EFFLUENT AND INFLUENT SEEPAGE ON THE HYDSODYNAM PORCES ACTING ON AN IDEALIZED MONCOHESIVE SEDIMENT PARTICL W70-09410 HYDRAULIC STRUCTURES
A CRITICAL STUDY OF THE TREORIES CONCERNING UPLIFT IN
HYDRAULIC STRUCTURES ON PERVIOUS FOUNDATIONS,
W70-09044
08D HYDRAULICS
THE DETERMINATION OF THE TRANSPORT COEFFICIENTS OF CELLULO: ACETATE MEMBBANES, W70-09357 ENERGY AND HYDRAULIC TESTS ON MECHANICAL AERATION SYSTEMS, , W70-095Q3 HYDROCARBONS
THE EFFECT OF SALINITY ON THE OXIDATION OF HYDROCAFBONS IN I ESTUABLING ENVIRONMENTS, HYDROELECTRIC PLANTS

UNITED STATES V WILLOW RIVER POWER CO (IMPAIRED EFFICIENCY!
OF HYDROELECTRIC PLANT CAUSED BY RAISING THE WATER 1EVEL OFF
THE FIVER ON WHICH IT WAS LOCATED).

W70-09073

06E HYDROELECTRIC POWER NAGARA FALLS POWER CO V DURYEA (RIGHT OF STATE TO CHARGE FOR WATER USE).
W70-09063 HYDROGEN BONDING A BONDING MODEL FOR ANOMALOUS WATER, W70-09126 HYDROGEN ION CONCENTRATION

RESPONSE OF DATRY WASTE ACTIVATED SLUEGE TO EXPERIMENTAL CONDITIONS AFFECTING PH AND DISSOLVED OXYGEN CONCENTRATION,

OSD HYDROGECLCGY SUMMARY OF GROUNDWATER OCCURRENCE IN CALIFORNIA, W70-09214 02F HYDROLOGICAL ANALYSIS OF VOLCANIC TERFANE THE RIC GRANDE DE SAN HIGUEL, EL SALVACOR, W70-09370 03B LOWER PASIN OF THE USE OF SEISHIC REPRACTION AND GRAVITY METHODS IN HYDROGECLOGICAL INVESTIGATIONS, BGREEOLE GEOPHYSICS AS APPLIED TO GROUNDWATER, #70-09400 A REVIEW OF SOME PROBLEMS OF SEISMIC FROSPECTING FCR GROUNDWATER IN SURFICIAL DEPOSITS, W70-09402 07B HYDROGRAPHY STUDY OF THE USE OF ARRIAL AND SATELLITE PHOTOGRAMMETRY FOR SURVEYS IN HYDROLOGY, HYDROLOGIC ASPECTS
HYDROCHEMICAL CHARACTERISTICS OF SMALL RESERVOIRS IN SOME
DISTRICTS OF THE CENTRAL CHERNOZEM FRCVINCES,
02K HYDROLOGIC BUDGET
HETHOD FOR COMPUTING GROUNDWATER LEVEL FLUCTUATIONS, #70-09103

O2P WATER BUDGET OF UPPER KLAMATH LAKE SCUTHWESTERN OFEGON, W70-09250 02R HYDROLOGIC DATA
A PROPOSED STREAMFLOW DATA PROGRAM FOR MAINE,
W70-09353 07A GROUNEWATER RECORDS OF SOUTH CAROLINA - 1 W70-09411 HYDROCHENICAL CHARACTERISTICS OF SMALL RESERVOIRS IN SOME DISTRICTS OF THE CENTRAL CHERNOZEM PRCVINCES, W70~09419 02K RUNOFF SYNTHESIS FOR BAIN-OR-SHOW EASIN, W70-09027 HYDROLOGY
HYDROLOGICAL BIBLIOGRAPHY.
W70-09376 HYSTERESIS IN TWO SANDS AND THE INDEFENDENT DOMAIN HODEL,

SUBJECT INDEX ICE-IN

I JAMS OBLANK CARPET MILLS, INC. W. NEW YORK (DAMAGES FROM FLOOD AND ICE JAM). 170-05157

0.2G

70-09209

E FCG A CONTRIBUTION TOWARDS THE REDUCTION OF ICE FOG CAUSED BY BUMIL STACK GASES AT ALASKAN FOWER STATIONS, 770-C9172

E JABS

WOHANK CARPET MILLS, INC V STATE (FLOODING CAUSED BY STATE'S NEGLIGENCE IN CANAL CONSTRUCTION).

W70-09458

ED LAKES
CHEMICAL COMFOSITION OF THE ICE OF OTKAZNENSKIY RESERVOIR,
W70-09097
O2K

ABO
EXPROLOGY OF THE UPPER MALAD RIVER BASIN, SOUTHEASTERN
IDAHC,
W70-09132
. 02E

EURLEY IRRIGATION DIST V ICKES (RIGHTS TO PROFIT FROM DAM CEFFATION). \$70-09472

TINCIS
CROSEY W DE LAND SPECIAL DRAINAGE DIST (VALUE TO PARHLAND OF IMPROVED DRAINAGE SYSTEM).
04A
04A

CARTER CIL CO V WATSON (BOUNDARY DISPUTE WHERE LAND CONVEYED BERDERED ON A STEERM). - - 06E

EABCOCK V MISSISSIPPI RIVER POWER CO (INJURY TO LAND VIA DAM CONSTRUCTION).

#70-09078

COMM'RS OF DRAINAGE DISTRICT NO 5 V ARNOLD (JUDICIAL INTERFRETATION OF DRAINAGE STATUTE). 870-09154

EAY ISLAND TRAINAGE AND LEVEE DIST NO 1 V NUSSEAUN (OPERATION COSTS OF FUNDING FACILITY). W70-09155

GECUNDWATER DISCHARGE IN THE ILLINCIS BASIN AS SUGGESTED BY TEMPERATURE ANCHALIES, W7C-092C1 02F

CARTER CIL CO Y DELHORTH (LESSEE OF LAND ABUTTING CREEK HAS RIGHT TO CREEK BED). 06E

HEACT(HAINFALL)

IFFECTS OF BAINFALL ON SETTLING VELOCITY OF SUSPENDED
SEPIMENT IN QUIESCENT WATER,

#76-09120.

02J

INFLUENCE OF RAINFALL ENERGY CN SOIL LOSS AND INFILTRATION FATTS 2. FFFECT OF CLOC SIZE DISTRIBUTION, 876-09378

MEAIFED WATER QUALITY
THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN
CONCENTRATION IN THE DELAWARE RIVER,
970-09149
050

MECUNDED WATERS
EARCOCK V MISSISSIPPI RIVER POWER CQ (INJURY TO LAND VIA DAM
CCNSTBUCTICE).
W70-09078
06E

BECKFORD PAPER MILLS, INC V CITY OF ROCKFORD (FLOOD DAMAGE TO FAM AND CTHEE PROPERTY FROM NEGLIGENT DAM OPERATION). W70-09496

MIIAN RESERVATIONS UNITED STATES V MCINTIRE (OWNERSHIE OF WATER RIGHTS ON INDIAN FESERVATION). 06E

UNITED STATES V WALKER RIVER IRRIGATION DIST (RIGHT TO USE OF SIEBRAM BASED ON FRIOR APPROPRIATION). 06E

NUCCEL INFILITATION
ELECTROLYTIC MODEL STUDY FOR COLLECTOR WELLS UNDER RIVER
EEDS, 02F

NOUSIFIAL WASTES
IN-FLANT WASTE REDUCTION, 05D

FOLYMER FIUS MAGNETIC FIELD USED TO TREAT PARAMAGNETIC. STUFFILES, W70-09318

EUROPEAN WASTE WATER MANAGEMENT AND RESEARCH, 05D

FLEXIBILITY KEY TO DESIGN OF MACHINING PLANT'S TREATMENT FACILITIES, 05D W70-09326

BOD AND COLOR REMOVAL FROM KRAFT MILL WASTES, $\ensuremath{\text{W}} 70-09330$

TREATMENT OF DAIRY MANURE BY LAGOONING, W70-09335

ECONOMICS OF CANNERY WASTE TREATMENT, W70-09338 05D

TREATMENT AND SLUDGE DISPOSAL OF WASTES FROM THE MANUFACTURE OF ACTIVATED CAREON, W70-00319

THE ORIGIN AND CHARACTERISTICS OF TOXIC WASTES, WITH PARTICULAR REFERENCE TO THE HETAL INDUSTRIES, W70-09340 05D

INFILTRATION
ON USING A TIME VARIABLE INFILTRATION WITH THE ISPAELSON ECROER IRRIGATION EQUATION,
W70-05141 03P

INFILTRATION RATE AS RELATED TO HYDRAULIC CONDUCTIVITY, MOISTURE DEFICIT AND OTHER SOIL PROPERTIES, W70-09360 02G

INFILTRATION IN TERMS OF SOIR MOISTURE, BAIN INTENSITY AND DEPTH OF BAINPALL, W70-09301

THE MOVEMENT OF WATER IN SANDY SOILS AFTER PLOUGHING AT A DEFTH OF 50 CENTIMETERS, W70-09303 02G

ANALYSIS OF INFILTRATION INTO STRATIFIED SOIL COLUMNS, w70-09306

A LINEARIZATION TECHNIQUE FOR THE STUDY OF INFILTRATION, W70-09307

ABSORETION AND INFILTRATION IN TWO- AND THREE-DIMENSIONAL STETERS, W70-09310 02G

INPILITRATION PROPERTIES OF THE SOILS OF THE CENTRAL CHERNCAPE FROVINCES, W70-09313 02G

AN APPROXIMATE METHOD FOR DETERMINING THE HYDRAULIC CONDUCTIVITY FUNCTION OF UNSATURATED SOIL, W70-09342 02G

INJECTION WELLS
FINGER IMBEDITION IN ARTIFICIAL REPLENISHMENT OF GROUNDWATER
THROUGH CRACKED POROUS MEDIUM,
W70-09200
02F

INJUCTION (MANDATORY)
HINDEHLIDER V LA PLATA RIVER AND CHERRY CREEK DITCE CO
(EQUITABLE APPORTIONNENT OF INTERSTATE STREAM THROUGH USE OF
INTERSTATE COMPACT).
06E

INJUNCTION
ICKES V FOX (INCREASED WATER RATES IMPOSED CONTEARY TO LAW).
W70-09067
06B

BROWN W NORTH ST LUCIE RIVER DRAINAGE DIST (DUTY OF LANDCWNEFS TO MAINTAIN LATERALS CONNECTING TO DITCH OF DRAINAGE DISTRICT).

06E

INJUNCTION (BESTRAINING)
ACKERHAN V TOWNSHIP OF NORTH HUNTINGDON (MUNICIPAL AUTHORITY
TO GRANT RIGHTS IN PRIVATELY OWNED SEVER LINE).
W70-09053

INSECT CONTROL
PROCEEDINGS WORKSHIP ON MOSQUITO CONTROL IN MORTH CAROLINA, W70-09421

INSTITUTIONS NATIONAL INSTITUTE OF ECOLOGY AN INCUIRT, VOLUMES 1 AND 2. W70-09366

CHAPTER 6 FEDERAL ORGANIZATION FOR BANAGING THE ENVISONMENT. W70-09444 06E

INSTRUMENTATION
P-N JUNCTIONS--A TOOL FOR TEMPERATURE MEASUREMENT,
N70-09212
078

MEASUREMENT OF THE THERMAL CONDUCTIVITY OF FROST FY A TRANSIENT HOT-WIRE TECHNIQUE, W70-09233

SCIL WATER DIFFUSIVITY AND WATER CONTENT DISTRIBUTION DURING OUTFLOR EXPERIMENT, 02G

DETERMINATION OF CAPILLARY CONDUCTIVITY AND DIFFUSIVITY OF SOIL IN SITU, 02G

DETERMINATION OF PORE SIZE BY THE AIR BUBBLING PRESSURE METRCE, 970-09297

THE RELATION BETWEEN PARTICLE SIZE, PORE SIZE AND HYDRAULIC CONDUCTIVITY OF SAND SEPARATES,

INT-LAE 02G INTERNATIONAL HYDROLOGICAL DECADE
EXPERIENCES WITH SNOW PILLOWS IN NORWAY,
02C INTERSTATE CORPACTS
HINDERLIDER V LA PLATA RIVER AND CHERRY CREEK DITCH CO
(EQUITARLE AFFCRITORERT OF INTERSTATE STREAM THROUGH USE OF
INTERSTATE COMFACT).
W70-09065 NEEFASKA V WYOHING (APPORTIONMENT OF INTERSTATE WATERS UNDEE FEICE AFFROFEIATION), N70-09461 06E INTERSTATE RIVERS
EINDERLIDER V LA PLATA RIVER AND CHERRY CREEK DITCH CO
(EQUITABLE APPORTIONMENT OF INTERSTATE STREAM THROUGH USE OF
INTERSTATE CCHFACT).

C6E COLORADO V KANSAS (AFFORTIONMENT OF WATER BETWEEN UPRIVER AND CONFITURE STATES).
870-09460 06E ERCOKS V UNITED STATES (JURISDICTION OF FEDERAL COURT TO LETERATE WATER RIGHTS IN INTERSTATE RIVER). W70-C947C 06E THE NEW BRUNSWICK ELECTRIC POWER COMMISSION SOLID STATE-STATE HVDC ASYNCHRONOUS THE INSTALLATION, W70-09012 08C INVESTEEFATES
A STUDY OF THE AQUATIC ECOSYSTEMS IN TWO NATIONAL WATERFOWL EFFORES IN MISSISSIPPI, W70-09346
021 IOCINE RADIOISOTCPES
LETTEMBERTOR OF THE VELOCITY AND DIRECTION OF GROUNDWATER
FLOW BY RADIOISCTOFES,
W70-09366
02F ION EXCHANGE COUNTERCORRENT ICM EXCHANGE. W70-09037 05F EXPERIMENTS ON THE ACCORPTION OF AMMONIQUE IONS BY CLAY FARTICLES IN NATURAL WATERS, 02K ICM TEAMSFORT
CESERVATIONS ON ACTIVITY AND DIFFUSION COEFFICIENTS IN NA-ECHTEORILLOBITE. LESIGN AND CONSTBUCTION SYSTEM FOR THE DETERMINATION OF TRANSPORT AND COMPACTION COMPFICIENTS OF REVERSE OSMOSIS BEMERANES, N70-09356 THE DETERBIBATION OF THE TRANSFORT COEFFICIENTS OF CELLULOSE ACTIAIN RESERVANCES, W70-09357 FFFICTS OF SALTS AND ORGANIC MATERIALS ON THE HYDPAULIC COMBUCTIVITY OF THE SOILS, W10-6290 02g FIOOD FIAIN MANAGEMENT - IOWA'S EXPERIENCE. 670-09253 FLOODS IN ICNA, N70-09254 02E FIGOD PLAIN MAFFING BY THE U. S. GEOLOGICAL SURVEY, B70-09255 FATHE V HISSOURI VALLEY DRAINAGE DIST BO 1 (CONSTRUCTION OF NEW SETTLING BASIN AS REPAIR OF OLD BASIN). W70-C9490 04D HILLER V HONORA COUNTY (ERAINAGE DISTRICT LIABILITY FOR BUTSANCE).

C4A BOGDE V WONCHA-BARRISCH DEAINAGE DIST (PROTECTION OF PRIVATE FROPERTY PROM PLOODING CAUSED BY DEAINAGE IMPROVEMENTS). W70-09494 IECH FHOSPHOROS REHOVAL BITH FERRIC IRON AND ALUMINUM, 870-09507 05D IBRIGATED AGRICULTUR.

THE EFFECT OF SOIL HOISTURE LEVEL OF THE INCIDENCE OF EARLY ELIGHT CM PCTATO AND TORATO PLANTS, W70-09137

RIGRATICH OF SOUBLE SALTS IN AN IBRIGATED FIELD IN DELATION TO RAINFALL AND IRRIGATION, N70-C9140 03C

IRBIGATION IN THE LEACHING OF SPLINE LAND IN SOUTHERN

KAZAKHSTAW,

DIGESTED SLUDGE DISPOSAL CH CROP LAND, FORAGE CROP IRRIGATION WITH OXIDATION FORD EFFLUENT, W70-09423 IRRIGATION CANALS

REDUCTION OF SEEPAGE LOSSES FROM IRRIGATION CANALS AS A
RESULT OF SILTING,

W70-09043

03P IBRIGATION DESIGN
HYDRAULIC DESIGN FOR CHECK METHOD OF IRRIGATION,
E70-09136
03F IRRIGATION DISTRICTS

BUBLEY IRRIGATION DIST V ICKES (RIGHTS TO PROFIT FROM DAM!

OFFRATICE). IRRIGATION OF SOLUBLE SALTS IN AM IRRIGATED FIELD IN RELATION OF SOLUBLE SALTS IN AM IRRIGATED FIELD IN RELATION TO RAINFALL AND IRRIGATION, W70-C9140 03C IRRIGATION FROGRAMS
UNITED STATES V MCINTIRE (OWNERSHIP OF WATER RIGHTS ON INDIAN RESERVATION).
W70-09169
06E IRRIGATION SISTEMS
UNITED STATES EX REL SIERRA LAND AND WATER CO V ICKES
(GOVERNEEMT GRANTS OF RIGHTS-OF-WAY OVER PUBLIC LANDS FOR
IBBIGATION SISTEMS).
W70-09480
03F IRRIGATION WATER
DRY LANDS AND DESALTED WATER,
W70-09030 030 POST-IBRIGATION MOVEMENT OF SOIL WATER 1. REDISTRIBUTION,N W70-09124 02G UNITED STATES V WALKER BIVER IBRIGATION DIST (RIGHT TO USE E OF STREAM BASED ON PRIOR APPROPRIATION). W70-09174 HYDROLOGICAL ANALYSIS OF VOLCANIC TERRANE LOWER FASIN OF THE BIO GRANDE DE SAN HIGUEL, EL SALVADOR, W70-09270 03B ISLAND CWPERSHIP
BLASK V SOWL (OWNERSHIP OF ISLANDS IN NAVIGABLE WATERS).
W70-09175
06E ISLANDS
BLASK V SOWL (OWNERSHIP OF ISLANDS IN NAVIGABLE WATERS).
W70-09175
06E ISRAEL FACTORS AFFECTING SPED GERMINATION UNDER SOIL MOISTURE STRESS, W70-09135 THE EFFECT OF SOIL MOISTURE LEVEL OF THE INCIDENCE OF EARLY BLIGHT ON POTATO AND TOWATO PLANTS, N70-09137 ISRAELSCH BORDER IRRIGATION EQUATION
ON USING A TIME VARIABLE INFILTRATION WITH THE ISRAFLSON
ECRDES IRRIGATION EQUATION,
W70-09141 JURISDICTION
BROOKS V UNITED STATES (JURISDICTION OF FEDERAL COURT TO DETERBRINE WATER RIGHTS IN INTERSTATE RIVER).
W70-09470
06E NANSAS
COLORADO Y KANSAS (APPORTIONMENT OF WATER BETWEEN OPBIVER
AND COMMRIVER STATES).
W70-09460
06E KARST TIDAL FREHOMENA IN THE KARSTIC WATER LEVEL, B70-09368 02P KAZAKHSTAN
EXPERIMENT IN THE LEACHING OF SALINE LAND IN SOUTHERN
KAZAKHSTAN,
N70-09258
03C SANDERS V BOSE (PROPERTY BOUNDARY AS AFFECTED BY CHANGE IN COURSE OF STREAM). W70-05059 COMMCN ERRORS IN DEVELOPING A GROUNDWATER AQUIFER, W70-09225 FLUCTUATION OF REFFLUENT QUALITY IN ACTIVATED SLUDGE FLANTS, 870-69504 KINETIC ASPECTS OF THE TREATMENT OF PERMOLIC WASTES, W70-09506 LABOR
COMSERVATION OF CRAFT SKILLS IN DESIGN,
N70-09033 ORF

SUBJECT INDEX

AECEATORY TESTS
TRACER STUDIES ON THE MOVEMENT OF SAND AND GRAVEL,
170-09024
C2J

CAPILLARY CONDUCTIVITY DATA ESTIMATED BY A SIMPLE METHOD,

AM INFILTRATION METHOD FOR THE DETERMINATION OF THE CAPILLARY CONDUCTIVITY OF UNDISTURBED SOIL CORES, W70-09281

AN EMPIRICAL EXPRESSION FOR THE DESORPTION CURVE, 870-09292 026

INFFAREL SPECTROPECTCMETBIC STUDY OF WET CLAY SOILS (FRENCH),

TETERMINATION OF PORE SIZE BY THE AIR BUEBLING PRESSURE RETHOD, \$70-09257 07B

THE PELATION BETWEEN PARTICLE SIZE, PORE SIZE AND HYDRAULIC CONDUCTIVATY OF SAND SEPARATES,

N70-09258 02G

ANALYSIS OF INFILTRATION INIC STRATIFIED SOIL COLUMNS, W70-09306 02G

LESIGN AND CONSTBUCTION SYSTEM FOR THE DETERMINATION OF TRANSPORT AND COPPACTION COEFFICIENTS OF REVERSE OSMOSIS

EFMERANES, 03A

GCCNS
A SUMMARY OF PEFLIMINABLY STUDIES OF SEDIMENTATION AND
EYPTROLOGY IN BOLINAS LAGGON, MARIN COUNTY, CALIFORNIA,
E70-09235
021

AFRATED LAGCONS TREAT SECONDARY EFFICIENT, 05D

TREATMENT OF DATRY MANURE BY LAGOONING, 05D

LAKE PAIKAL ON PRECIPITATION IN PAIKAL ON PRECIPITATION IN THE SUBROUNLING REGIONS, U2D W7C-09096

LAKE FEES
HONEBELD W MONTICELLO (DEED TO LAKE FRONTAGE AS NOT EXTENDING CWNEFSHIP TO LAKE BED).

ANE CHAFFIAIN

LAKE CHAPFIAIN EALY V STATE (FIGOD DAMAGES CAUSED BY CANAL CONSTRUCTION). W70-09143

TARE ESTE DISFERSION FREDICTION FROM CUBBENT METERS, W70-09219

LAKE CETABLE

MCNIBLY MEAB SURFACE TEMPERATURES FOR LAKE ONTARIO AS
LETERMINED BY ABRIAL SURVEY,
W70-09206

02H

LAKE SHORES EBANT LAKE SHORES, INC V BARTON (ADVERSE POSSESSION OF LAND EFLOR THE HIGH WATER MARK). 06E WYO-05355

LARES
INFLUENCE OF EVAPORATION FROM LAKE BAIKAL ON PRECIPITATION
IN THE SURRCUNLING BEGIONS,
870-09096

WATER BURGET OF UPPER KLAMATH LAKE SOUTHWESTERN OREGON, W70-09250

THE BALANCE METECD OF COMPUTING SEDIMENT FLOW AND ESTIMATING THE RATE OF SILTING OF RESERVOIRS, U2J W70-09315

MAP OF EVAPORATION FROM SMALL RESERVOIRS OF THE CENTRAL CHERNOZEM FAOVINCES, 02D

E70-09413

CEABACTERISTICS OF SILTING OF SHALL BESERVOIRS OF THE CENTRAL CHENOZEM PROVINCES AND CONFUTATION OF DENSITY OF FCTICE DEFCSITS, 02J

DEVELOPING A HETHOD OF COMPUTING SILTING OF SHALL RESERVOIRS IN THE CENTRAL CHERNOZEM PROVINCES, W70-09418

IN THE CENTRAL CHERNOZEM PROVINCES, 02J W70-094 TE CHERNOZEM PROVINCES, 02J W70-09108 AND SUBUBBIA. 06B W70-09108

LAND HANAGEBERT COASTAL EXTLANDS OF VIRGINIA-INTERIM REPORT, 070-09350

TARD SECLAMATION
EXPERIMENT IN THE LEACHING OF SALINE LAND IN SOUTHERN RAZAKHSTAN,
W70-09258

LAND TENURE VARNET RIVER DRAINAGE DIST V SPIEDEL (ASSESSMENTS CN LAND HELD BY EQUITABLE TITLE). W70-09058

BURAS V ELLZEY (POSSESSORY RIGHTS IN WATERFRONT PROPERTY) - W70-09323 06E

LAND USE
SOIL, WATER AND SUBURBIA.
W70-09188

06B

LAND USE FOLICIFS
SCIL, WATER AND SUBURBIA.
W70-09188 06B

LANDFILLS
CITY OF NEW YORK Y WILSON AND CO (EJECTMENT ACTION BY CITY
SLEKING POSSESSION OF FILLED LANDS ORIGINALLY BELOW THE HIGH
WATEF HARK OF BIVER).
#70-09142
06E

LATERAL FORCES

LATERAL PRESSURES ON RIGID PERMANENT STRUCTURES,
W70-09045

08D

LATERALS
BROWN V NORTH ST LUCIE RIVER DRAINAGE DIST (DUTY OF
LANDCWNERS TO MAINTAIN LATERALS CONNECTING TO DITCH OF
DRAINAGE LISTRICT).

06E

LATOSOIS

REFECTS OF SALTS AND ORGANIC MATERIALS ON THE HYDRAULIC CONDUCTIVITY OF THE SOILS, W70-09290 026

LEACHING
EXPERIMENT IN THE LEACHING OF SALINE IAND IN SOUTHERN
KAZAKHSTAN,
W70-09258
03C

LEAD FALLOUT
LEAD IN A SUBURBAN ENVIRONMENT,
W70-09251 02K

LEARAGE
LEARAGE THROUGH BURIED CHANNELS,
W70-09049
04.

LEASES
CARTER OIL CO V DELWORTH (LESSEE OF LAND ABUTTING CREEK HAS BIGBT TC CREEK BED).
W70-09468
06E

LEATHER WASTE
CATTLE SAIN TANNERY WASTES TREATMENT IN A COMPLETELY MIXED
ACTIVATED SLUDGE PILOT PLANT,
U70-C9224
05D

LEGISLATICH
YEARSLEY W WA ROSS CONST CO (LIABILITY OF FRIVATE
CORPORATION ACTING PURSUANT TO AN ACT OF CONGRESS).
W70-09070

COMBORS OF DRAINAGE DISTRICT NO 5 W ARNOLD (JUDICIAL INTERPRETATION OF DRAINAGE STATUTE). 04A

LEVEES
UNITED STATES V SPONENBARGER (ALLEGED TAKING OF PRIVATE
PROPERTY WITHOUT JUST COMPENSATION VIA FLOOD CONTROL FLAM).
870-09068

PAIN BEACH COUNTY V SOUTH FLORIDA CONSERVANCY DIST (DRAINAGE DISTRICT'S USE OF LEVEE FOR CONSERVATION PARAMOUNT TO COUNTY'S USE AS A PUBLIC ROAD).

OGE

LINEAR ALKYLATE SULPONATES
ANDONIC AND NONIONIC SURFACTANT SORPTION AND DEGRADATION BY
ALGAE CULTURES,
W70-09438

LOADINGS

EFFECT OF RECIRCULATION ON DEEP TRICKLING FILTER
PERFCRANACE,
05D

DEGRADATION OF WASTE WATER ORGANICS IN SOIL, 970+09329

TREATMENT OF DAIRY NAMURE BY LAGOONING, U70-09335

LOCAL GOVERNMENTS

ACKERHAN V TOWNSHIP OF MORTH HUNTINGDON (MUNICIPAL AUTHORITY OC GEART RIGHTS IN PRIVATELY OWNED SEVER LINE).

06E

MAFFEI W BERRIEM COUNTY (COUNTY'S LIABILITY FOR FLCCO DAMAGE CAUSED BY NEGLIGENT MAINTENANCE OF DRAINAGE SYSTEM). W70-09492

LOUISIANA DICKSON V SANDEPUR (DISPUTED OWNERSHIP OF LAND APPEARING AFTER SUDDEN SHIPT IN RIVER'S COURSE).
06E 070-09060

BURAS V ELLZEY (POSSESSORY RIGHTS IN WATERFRONT PROPERTY).

LCU-MEA

970-09323 06E

CCOFFE V CITY OF BOGALUSA (PEDERAL RESPONSIBILITY FOR LAMACES CAUSED BY NAVIGATION IMPROVEMENTS). W70-09486

SCCII W RED RIVER-BAYOU FIRRE LEVEE AND DRAINAGE DIST (RIGHT TO COMPENSATION FOR EXPROPRIATED LAND). 870-05467

LCW FLCW AUGHENTATION
APPLICATION OF SPECIALIZED OPTIMIZATION TECHNIQUES FOR WATER
QUALITY AND QUANTITY MARACEMENT WITH RESPECT TO FLANNING FOR
THE TRINITY RIVER BASIN,
05G
05G

MACHINERY FLANT
FIEXTELLITY KEY TO DESIGN OF MACHINING PLANT'S TREATMENT
FACILITIES,
W70-09326
05D

MAGNETIC STUDIES
ELECTROPAGNETIC AERIAL SURVEY OF A FRESH WATER-SALT WATER
CCNTACT IN THE RHONE DELTA (FBENCH),
W70-09394

MAGNETCHYCRCDYNAMIC FCWER
RUSSIANS PUSH MAGNETOHYDRODYNAMIC POWER,
W7C-C9167 08C

MAINE
A PROPOSED STREAMFLOW DATA PROGRAM FOR MAINE,
W70-09353 07A

MAINTENANCE
CFERATION AND MAINTENANCE OF LARGE HYDRO TUBBINES - COLUMBIA
AND SNAKE RIVERS,
876-09047
08C

AH EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM ELSIGN, ETO-00185

HANAGEMENT HANTER QUALITY FLANNING AND MANAGEMENT (FLANNING ESSENTIAL TC INSER NATES QUALITY), H70-09056 05G

EUROPEAN WASTP WATER MANAGEMENT AND RESEARCH, W70-09322 05D

CEAPTER 1 INTRODUCTION. W70-09439 06B

CHAPTER 2 INSTITUTE FOR ANALYTICAL STUDIES. W70-09440 06E

CHAPTER 6 FEDERAL ORGANIZATION FOR MANAGING THE ENVIRONMENT. #70-09444 06E

MAFFING FLAIN MAFFING BY THE U.S. GEOLOGICAL SURVEY, E70-09255

MARINE FISHERIES

FFFECTS OF THERMAL DISCHARGE FROM THE SAN ONOFRE NUCLEAR
GENERATING STATION,
W70-09165

05C

HABINE FLANKTON
FRELIMINABY RESULTS OF THE EXPERIMENTS ON THE TOXICITY OF
CIL CCUNTERACTING AGENT (ESSC CCREXIT 7664), WITH AND
MITHOUT IRAC CRUDE CIL, FOR SELECTED MEMBERS OF HARINE
FLANKTON,
FLORONIZA

MABINE FLANTS

EFFECTS OF THERNAL DISCHARGE FROM THE SAN ONOFFE NUCLEAR
GENERATING STATION,

W70-09165

05C

HARMOT CREEK EXPERIMENTAL MATERSHED (CANADA) AN ENERGY EDDGET STOLY ABOVE THE POREST CANOPY AT HARMOT CREEK, ALBERTA, 1967, W70-09111

MABYLAND
FCLLUTION OF ESTUARIES,
W70-09383
050

MASSACHUSETTS
BOLYOKE WATER FOWER CO V AM WRITING PAPER CO (USE OF WATER FOWER BEYONG SCOPE OF GRANT).
W70-09475
06E

FILTRATION OF WASTE PLANT EPFLUENTS, W70-09317 05D

ALVANCES IN HANCLING GAS CHICFINE, W7Q-09319 . 05D

BATHEMATICAL BODEL
TWO LAYER HODEL OF STEATIFIED FLOW IN AN ESTUARY, W70-09152 02L

HATHEMATICAL EGDELS
TRACER STUDIES ON THE MOVEMENT OF SAND AND GRAVEL, N70-09024
02J

NUMERICAL MODELING OF UNSATURATED GROUNDWATER FLOW AND COMPARISON OF THE MODEL TO A FIELD EXERTMENT, 970-09107

ANALYSIS OF LAG PHASE BOD CURVES USING THE MONOD EQUATIONS, $\mbox{W70-09122}$

A NUMERICAL TECHNIQUE FOR CALCULATING THE TRANSIERT POSITIO OF THE SALTWATER FRONT,

DIGITAL ANALYSIS OF AREAL FLOW IN MULTIAQUIFER GROUNDWATER SYSTEMS A QUASI THREE-DIMENSIONAL MODEL, W70-09197 02P

FINITE ELEMENT METHOD OF ANALYZING STEADY SEEFAGE WITH A FREE SURFACE, W70-09198 02G

A MOVING BOUNDARY MODEL OF A ONE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIENT POROUS FLOW SYSTEM, W70-05159 02G

FINGER IMBIBITION IN ARTIFICIAL REPLENISHMENT OF GROUNDWATER: THROUGF CRACKED POROUS HEDIUM, W70-09200 02F

A DIUFNAL DISTRIBUTION FUNCTION FOR DAILY EVAPORATION, W70-09205

DISPERSION IN HOMOGENEOUS ESTUARY FLOW, W70-09217 02L

ANALYSIS OF INFILTRATION INTO STRATIFIED SOIL COLDENS, W70-09306 02G

DISSOLVED SOLIDS-DISCHARGE RELATIONSHIPS 1. MIXING MODELS, W70-09311 02K

BOD MASS BALANCE AND WATER QUALITY STANDARDS, W70-09349 05A

ON THE SYSTEMS APPROACH IN HYDROLOGY, W70-09365 02A

MATHEMATICAL STUDIES
DETERMINATION OF THE COEFFICIENTS OF WATER MIGRATION THROUGH
SOILS,
W70-09283
02G

A THEORETICAL ANALYSIS AND NUMERICAL SOLUTIONS OF UNSATUFATED FLOW IN SOIL, W70-09305 02G

A LINEARIZATION TECHNIQUE FOR THE STUDY OF INFILTRATION, $\ensuremath{\text{W70-09307}}$

ABSORETICN AND INFILTRATION IN TWO- AND THREE-DIMENSIONAL SISTEMS, W70-C9310 - 02G

DEVELOPING A METHOD OF COMPUTING SILTING OF SHALL PESERVOIRS IN THE CENTRAL CHERNOZEM PROVINCES, W70-09418 02J

AN ANALYTICAL METHOD FOR EVALUATING THE SUSCEPTIBILITY OF PISH SPECIES TO AN AGRICULTURAL CHEMICAL (JAPANESF), W70-09433

MAXIMUM EROBABLE PLOOD
TPOUT BROOK CO V WILLOW RIVER POWER CC (LIABILITY FOR DAM
FAILUBE DURING UNPRECEDENTED PLOOD).
W70-09029
OGE

HEAN ANNUAL FLOOD FLCODS IN IOWA, W70-09254

02E

HEANDER LINES
BLISS V KINSEY (EXTENSION OF BOUNDARY LINES FROM MEANDER LINE TC SHORE LINE).
W70-09343
06E

HEANDERS
THOMAS E BISHOP CO V SANTA BARBARA COUNTY (MERNIER LINES AS BOUNDAPIES).
W70-09082
06E

UNITED STATES V OTLEY (CWNERSHIP OF LAKE BEDS). $\ensuremath{\text{W}70-09467}$

A STUDY ON PRESSURE MEMBRANE PROPERTIES IN RELATION TO CAPILLARY CONDUCTIVITY MEASUREMENTS, W70-09279 02G

SOIL WATER DIFFUSIVITY AND WATER CONTENT DISTRIBUTION DURING OUTFLOW EXPERIMENT, W70-09280 02G

VALIDITY CONDITIONS OF THE POINT DILUTION METHOD, $w70\!-\!0928\varphi$

CIVERGENCES BETWEEN EXPERIMENTAL AND THEORETICAL VALUES OF CAPILLARY DIFFUSIVITY (FRENCH), W70-09285

ECHANICAI SUFFACE AEFATORS ENERGY AND EYDRAULIC TESTS ON MECHANICAL AERATION SYSTEMS, N70-09503

EMERANE CCMPACTION
THE DETERMINATION OF THE TRANSPORT COMPFICIENTS OF CELLULOSE
ACTIVE MEMERANES,
670-03357
03A

COMPACTION THEORY FOR MCDIFIED REVERSE OSMOSIS MEMERANES,

COMPACTION OF CHILUICSE ACETATE MEMERANES, 1070-09359

MEMERANE FECCESSES
IMPROVEMENT OF TUBULAR CELLULOSE ACETATE MEMBRANES BY FELD
ACCITIVES,

A STUDY ON FRESSURE MEMBEANE FROPERTIES IN RELATION TO CAPILLARY CONDUCTIVITY MEASUREMENTS, N70-09279

THE DETERMINATION OF THE TRANSPORT COEFFICIENTS OF CELLULOSE ACETATE NEMERANES, 470-69357

A COMPACTION THEORY FOR MCDIFIED REVERSE OSMOSIS MEMERANES, 870-09358

COMPACTION OF CHILULOSE ACETATE MEMERANES,

MEMERANES
FINAL REÇCRI ON REVERSE OSMOSIS MEMERANES CONTAINING
GRAFHITIC OXICE,
W70-09245
03a

HYDROCASTING FEVERSE OSMOSIS MEMERANES, 03A

DEVELOPMENT OF REVERSE OSMOSIS MEMBRANES 870-09362

AUTOMATED ACTIVATED SLUDGE PLANTS WITH RESPIRATORY METAECLISM CONTROL, 70-09502

METAL FINISHING INDUSTRY
THE ORIGIN AND CHARACTERISTICS OF TOXIC WASTES, WITH
FARTICULAE SEFERENCE TO THE HETAL INDUSTRIES,

MICHIGAN NE-EO-SHONE ASS'N, INC V HOGARTH (PUBLIC FISHING RIGHTS IN NAVIGABLE HIVERS). 06E 970-090E6

MEYEBING LAND CC V SPENCER (DRAINAGE DISTRICT HAS NO POWER TO CONSTRUCT SEWERS UNDER AUTHORITY FOR DRAIN CONSTRUCTION), W70-09488

CLSEN V CITY OF DEARBORN (EVALUATION OF PROPERTY PARTIALLY TAKEN FOR PUBLIC UTILITY FURFCSES). 06E

MAFFET V BEBRIEN COUNTY (COUNTY'S LIABILITY FOR FLOOD DAMAGE CAUSED BY NEGLIGENT MAINTENANCE OF DRAINAGE SYSTEM). 870-09492 ECCKECRE PAPER MILLS, INC V CITY OF ROCKFORD (FLOOD DAMAGE TO DAM AND CTHER PROPERTY FROM NEGLIGENT DAM OPERATION). W70-09496

CECEICICEY
CONTROL MECHANISMS OFFRATIVE IN A NATURAL MICROBIAL
POPULATION SELECTED FOR ITS ABILITY TO DEGRADE L-LYSINE, II.
EFFECTS OF FRUCTOSE AND RIBOSE IN BATCH SYSTEMS,
05D

CONTROL MECHANISMS OPERATIVE IN A NATURAL MICROFIAL FORULATION SELECTED FOR ITS ABILITY TO DEGRADE U-LYSINE, III. EFFECTS OF CARBOHYERATES IN CONTINUOUS-PLOW SYSTEMS UNDER SHOCK ICAL CCHLITICMS,

MICROBIOLOGY OF A WASTE STABILIZATION POND, W70-C9508 050

HILL FUNER HATER POWER CO W AM WRITING PAPER CO (USE OF WATER HOLVOKE WATER FOWER BEYOND SCORE OF GRANT) - 06E W70-09475

HINE DRAINAGE
HELATION BETWEEN THE 'ITAI-ITAI' DISEASE AND THE POLLUTION
CF BIVER WATER BY CALFIUE FECH A MINE,
05C
970-09427

MINE WASTES
LONDON EXTENSION MINING CO V BLLIS (OWNERSHIP OF ACCRETED IANDS). 06E
470-09465

MINERAL METABOLISM
MINERAL METABOLISM OF HALOPHYTES,
W7C-09147

MINIFAL RIGHTS
DUKE POWER CO V TOMS (POWER COMPANY'S RIGHT TO FLOOD ACCOMPANIED BY DUTY TO PAY DAMAGES).

06E

MINNESCTA
BEHRENS V CITY OF MINNEAPOLIS (PUBLIC PURPOSE REQUIREMENT FOR CHANNEL IMPROVEMENT). W70-09489

02T

ISSASSIFFI
WHATER-LEVEL AND WATER-QUALITY TRENDS IN AQUIFERS ALONG THE MISSISSIPPI GULF COAST, 1970,

THEMESON V CITY OF PHILADELPHIA (DAMAGE CAUSED BY CITY MAINTAINED SEWAGE SYSTEM). W70-09484

MISSCORI
VARRET RIVER DRAINAGE DIST V SPIEDEL (ASSESSMENTS ON LAND
HELD EY EQUITABLE TITLE).
W70-09058
06E

DANFORTH V UNITED STATES (COMPENSATION FOR TAKING OF PRIVATE

RECONNAISSANCE OF THE GROUNDWATER RESCURCES OF THE MISSOURI RIVER ALLOVIUM BETWEEN MIAMI AND KANSAS CITY, MISSCURI, W70-09249

MISSCURI EIVER
RECONNAISSANCE OF THE GROUNDWATER RESOURCES OF THE MISSOURI
RIVER ALLUVIUM BETWEEN MIAMI AND KANSAS CITY, MISSCURI,
W70-02249
02F

FINGER IMBIBITION IN ARTIFICIAL REPLENISHMENT OF GROUNDWATER THROUGH CRACKED POROUS MEDIUM, 02F

MODEL SIDDLES
RESTARCH INTO THREE-DIMENSIONAL SEEFAGE IN JOINTED BOCK FOUNDATIONS OF RIGH DAMS.

ON THE SOLUTION OF INVERSE PROBLEMS IN HYDROGEOLOGY

OPTIMIZATION OF WATER RESOURCES SYSTEMS BY THE GRADIENT PROJECTION AND THE CONJUGATE GRADIENT METHODS, W70-090°2

MOISTURE CONTENT INFRARED SPECTROPHOTOMETRIC STUDY OF WET CLAY SOILS (FRENCH), W70-09293 02G

INFLUENCE OF SOIL STRUCTURE ON INFILTRATION AND PF VALUES OF CHEPNOZEM AND CHERNOZEMLIKE DARK MEADOW SOILS, W70-09294

HOISTURE DEFICIT
INFILTRATION RATE AS RELATED TO HYDRAULIC CONDUCTIVITY,
MOISTURE DEFICIT AND OTHER SOIL PROFESTIES,
W70-09300 O2G

MOISTURE METERS
NUCLEAR TECHNIQUES IN HYDROLOGICAL INVESTIGATIONS IN THE
UNSATURATED ZONE,
W70-09272

MOISTURE STRESS
FACTORS AFFECTING SEED GERMINATION UNDER SOIL MOISTURE

THE STABILITY OF WHEAT EMBRYO GLUTAMATE DECARBOXYLASE UNDER CONDITIONS OF WATER STRESS, W70-09138

PHYSIOLOGICAL RESPONSES TO TEMPERATURE AND DESICCATION IN THE ENDERTO NEW MEXICO PLETHODONTIDS, PLETHODON NEGMEXICANUS AND ARELES HARDII, 021

WATER ECONOMY OF THE GREEN-TAILED TOWNER (CHLORURA CHLORURA), W70-09149

CALLERATION AND EVALUATION OF A WIDE BANGE METHOD FOR MEASURING MOISTURE STRESS IN FIELD SOIL SAMPLES, W70-09273

HOLLUSCACIDES
COMPARATIVE STUDIES OF THE MOLLUSCICIDAL EFFECT OF CUPROUS
CHIORIDE AND COPPER SULFATE IN IRAN,
870-09432

MONITORING

EFFECTS OF THERMAL DISCHARGE FROM THE SAN ONOFRE NUCLEAR

GENERATING STATION,

W70-09165

BON-NEW SUBJI
UNIVERSITY BOLE IN ASTRONAUT LIFE SUPPORT SYSTEMS WATER
FECCYERY SYSTEMS, N70-09236 05D
CBAFTEB 4 HONITORING THE ENVIRONMENT. W70-09442 07B
MONCD EQUATIONS ANALYSIS OF LAG PHASE BOD CURVES USING THE MONOD EQUATIONS, 670-09122 05A
BOBINCRILIONITE CESTEVATIONS ON ACTIVITY AND DIFFUSION COEFFICIENTS IN NA- FOUTBORILIONITE,
W70-09105 02K
MOSQUITCES FROCEEDINGS WORKSHIP ON MOSQUITO CONTROL IN NORTH CAROLINA, . W70-09421 06G
MOVAFIF BED MCDELS THE EFFECT OF BED-LOAD MOVEMENT ON THE VELOCITY DISTRIBUTION
CF FICH, N70-09052 02J
MUITIPHASE FLCW (FOROUS MEDIA)
THE THREE-PEASE CCMAIN IN HYDROLOGY, W70-09260 02F
MUITIFLE CBJECTIVE FLANNING EVALUATION PROCESSES IN WATER RESOURCES FLANNING. W70-05369 06B
BUITIFIE EURPCSE FRCJECTS SOIL, WATER AND SUBUREIA. W70-09188 06B
MUITIFIE-FURECSE FECJECTS SPACE HEATING IN URBAN ENVIRONMENTS, W70-09192 C8C
USES OF WASTE BEAT, W70-09193 03C
MODICIFAL WASTES AN EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM DESIGN, W70-09185 08A
MUNICIFAL WATER CITY OF NEW YORK W. NEW YORK WATER SERVICE COSP (CITY MAY GEDER AM. INCREASE IN WATER SUPPLY). 03D
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
UNIVERSITY BOLF IN ASTRONAUT LIFE SUPPORT SYSTEMS WATER BECOVERY SYSTEMS, W70-05236 05D
WATIONAL LABOFATORY FOR ENVIRONMENTAL SCIENCE CBAPTER 5 NATIONAL LABORATORY FOR ENVIRONMENTAL SCIENCE. W70-09443
NATURAL FLOW EL OF ELUC W NORTH HEMPSTEAD (NO RIGHT TO DAMAGES FOR
NATURAL FICE OF SURFACE WATERS). R7C-09055 06E
WATURAL FICW LOCTRINE ####################################
NAVIGABLE BLVERS NE-BO-SHOWE ASS'N, INC V HOGARTH (FUBLIC FISHING RIGHTS IN
NAVIGABLE RIVERS). R70-09066 OGE
UNITED STATES V WAUNA TOLL BRIDGE CO (OBSTRUCTION OF NAVIGABLE RIVERS).
\$70-09466 04A
NAVIGABLE NATERS FIKE RAFIDS POWER CO V HINNEAPOLIS ST P AND S S M RY (RELATIVE RIGHTS TO BIVER EFF AS BETTERN SHIDGE COMPR AND

LAM CWNES) . W70-09081

MIAMI EFACE JOCKEY CLUB, INC V DERH (GOVERNMENT CONTROL OVER CESTROCTIONS TO BAVIGATION).

06E

CKLABOHA EX REI FHILITS V GOV F ATKINSON CO (INJUNCTION AGAINST DAM CONSTBUCTION).

N70-09071

06E

W A BOSS COUST CO V YEARSLEY (GOVERNMENTAL LIABILITY POR TABAGES ARISING FROM INFROVEMENT OF NAVIGATION). W70-09163

BIAMI FEACH JOCKEY CLUB, INC V DERM (GOVERNMENT CONTROL OVER CBSTROCIOUS TO NAVIGATION).

062

A TEST OF FEDERAL WATER PROJECT EVALUATION PROCEDURES WITH DEFINESS ON REGICIAL INCOME AND EMVIRONMENTAL QUALITY DEFINED, 03P 03P

ERIE LACKAWANNA BY V SILLS (SUNKEN VESSEL OBSTRUCTING DOCKS

AS TRESPASS) . #70-09500

06B

NEGRY DESIRT
THE EFFECT OF SOIL MOISTURE LEVEL OF THE INCIDENCE OF EARLY.
BLIGHT ON POTATO AND TCHATO PLANTS,
W70-09137
021

TEMPERATURE-DEPENDENT CHARACTERISTICS OF PERIPHERAL NERVES TEXPOSED TO DIFFERENT THERMAL CONDITIONS IN THE SAME ANIMAL, W70-09160

NETWORK DESIGN
A PROPOSED STREAMPLOW DATA PROGRAM POR MAINE,
07A

NEUTRON HOISTURE GAGE (SURFACE)
CHANGES IN THE MOISTURE CONTENT OF THE TOPSOIL AS MEASURED
WITH A MEUTRON HOISTURE GAUGE,

NEUTRON-SCATTER MOISTURE METERS
AN INSTRUMENT FOR MEASURING SOIL MOISTURE ET NEUTRON
SCATTERING,
W70-09265
07B

ELEMENTAL SULPUR IN EDDY COUNTY, NEW BEXICO, W70-09128

HEART RATE AND CHANGES IN BODY FLUIDS IN AESTIVATING TOADS FROM XESIC HABITATS, W70-09148

NEW YORK

CITY OF NEW YORK W NEW YORK WATER SERVICE CORE (CITY MAY ORDER AN INCEEASE IN WATER SUPPLY).

W70-09025

03D

HONEFEIN V MONTICELLO (DEED TO LAKE FRONTAGE AS NCT EXTENDING OWNERSHIP TO LAKE BED). W70-09054

BD OF ECUC V NORTH HEMPSTEAD (NO RIGHT TO DAMAGES FOR NATURAL FICW OF SURFACE WATERS).

W70-09055

06E

DALY V NEW YORK (DAMAGES TO CROPS FROM BARGE CANAL CONSTRUCTION). W70-09061

IN RE FAST RIVER DRIVE (VALUATION OF SCENIC FASEMENTS IN CONDENNATION PROCEEDINGS). W70-09062 06E

NIAGARA FALLS POWER CO V DURYEA (RIGHT OF STATE TO CHARGE FOR WATER USE). $\label{eq:condition} \mbox{W70-09063}$

CITY OF NEW YORK W WILSON AND CO (EJECTMENT ACTION BY CITY SEEKING POSSESSION OF FILLED LANDS ORIGINALLY BELOW THE HIGH WATER HARK OF RIVER).

DALY W STATE (FLOOD DAMAGES CAUSED BY CANAL CONSTRUCTION). W70-09143

HOHARK CARPET HILLS, INC V NEW YORK (CAMAGES FROM PLOOD AND

SLIDE SCUNTAIN REALTY CO V STATE (CORDENATION VALUE OF A WATER ECDY AND DAM).

06E

NEW YORK HETROPOLITAN REGION--A MAJOF SEDIMENT SOURCE, W70-09203

FLOOD PIAIN INFORMATION, ALLEGHENY BIVER AND FIVEHILE CREEK, ALLEGANY, NEW YORK.
W70-09252 04A

BRANT LAKE SHORES, INC V BARTON (ADVERSE POSSESSION OF LAND BELOW THE HIGH WATER HARK). W70-09355

IN RE CITY OF NEW YORK (RIGHTS OF CWNERS OF BFDS SUBSERVIENT TO UFLAND OWNER'S RIPARIAN RIGHTS).

06R

MOBANK CARPET HILLS, INC V STATE (PLOCDING CAUSED BY STATE'S NECLIGENCE IN CANAL CONSTRUCTION).

W70-0948

BEARD'S ERIE BASIN V NEW YORK (RIGHTS TO COMPENSATION AWARD BASED ON ORNERSHIP OF LANDS CONDEMNED). W70-09463

ERIE LACKAWANNA RY V SILLS (SUNKEN VESSEL OBSTRUCTING DOCKS AŞ TRESFASS). 06E

NEW YORK STATE BARGE CANAL
DALY V NEW YORK (DAHAGES TO CROPS FROM BARGE CANAL
COMSTRUCTION).
W70-09061
06E

NEW YORK STATE BARGE CANAL CANALS
DALY V STATE (FLOOD DAMAGES CAUSED BY CANAL CONSTRUCTION).
870-05143

NEW-OPE

F YORK STATE BEALTH DEFABTMENT
RATER QUALITY A CONCERN FOR AGRICULTURAL ENGINEERS,
R7C-09459 05G

E ZEALANT EEPPARATON RESCRI OF THE TECHNICAL SUBCOMMITTEE ON SHOW. #70-09351

ITEATE NITRATE VARIATION IN GECUNDWATER, N70-09425

INSTALLATION FOR NITRATE REDUCTION

DETERGENTS, PHOSPHATES, AND WATER POLLUTION,

NITRATE VARIATION IN GROUNDWATER, #70-09425

CN+STRUCTURAL ALTERNATIVES FIGOD PLAIN HANAGEMENT - IOWA'S EXFERIFNCE.

FICCE CAMAGE PREVENTION - E70-09364

10

DUKE FOWER CO V TOMS (FOWER COMPANY'S RIGHT TO FLOOD ACCOMPANIED BY FUTY TO PAY DAMAGES).

06E

NCFIH DAKCTA GROUNDHATER BASIC DATA, PART 2 OF GEOLOGY AND GROUNDWATER
BESGURCES OF MERCER AND CLIVER COUNTIES, NORTH DAKOTA,
W70-09367

02F

NUCLEAR EXERGY
SPACE HEATING IN URBAN ENVIRONMENTS,
170-09192

NUCLEAS MCISTURE METERS
COMPARATIVE STUDY OF THE WATER BALANCE IN THE AFRATED ZONES
WITH BADIO-ACTIVITY METERDS AND WEIGHABLE LYSIMETER,
W70-09263
02G

MEASURING SOIL HOISTURE IN THE BRENIG CATCHMENT FRO OF USING NEUTRON SCATTER EQUIPMENT IN SOIL WITH PEATY

AN INSTRUMENT FOR MEASURING SOIL MOISTURE BY NEUTRON SCATTERING,

CHANGES IN THE HCISTURE CONTENT OF THE TOPSOIL AS HEASURED WITE A NEUTICH HOISTURE GAUGE, 02G

THE DETERMINATION OF SOIL MOISTURE WITH THE NEUTRON SCATTERING FETHER IN FINIANC, 078

NEUTRON HOISTURE METER FOR SALINE SOILS, W70-09268 07B

FOLISH ISOTOPE APPARATUS FOR RESEARCH ON SOIL MOISTURE, \$70-09271

BUCLEAR TECHNIQUES IN HYDROLOGICAL INVESTIGATIONS IN THE UNSATURATED ZONE,

EVALUATION OF SOIL MOISTURE MEASUREMENTS IN OKLAHOMA AS SOIL CHARACTERISTICS FOR CLASSIFICATION, 02G

A GAMMA-EHOIONEUTRON METHOD FOR LANCEATORY STUDIES OF SOIL

NUCLEAR PCRERELARTS

EFFECTS OF THEBHAL DISCHARGE FROM THE SAN OMOFRE NUCLEAR GENERALING STATION, N70-09165

SPACE HEATING IN UREAR ENVIRONMENTS, 08C

NUCLEAR REACTORS
SPACE HEATING IN URBAN ENVIRONMENTS,
08C

NUISANCE HILLER W HONOMA COUNTY (CRAIMAGE DISTRICT LIABILITY FOR NUISANCE). N70-09493

NUMERICAL ANALYSIS
A NUMERICAL TECHNIQUE FOR CALCULATING THE TRANSIENT POSITION
OF THE SALTBATER FROMT,
02L
02L

WATER QUALITY IN RELATION TO PRODUCTIVITY OF LAKE ASHTABULA RESERVOIR IN SOUTHEASTERN MORTH DAKOTA, W70-09093 5C

DETERGENTS, PHOSPHATES, AND WATER POLIUTION,

OAK RIDGE NATIONAL LABORATORY
COMPOSITION OF WATER IN CLINCH RIVER, TENNESSEE RIVER, AND
HHITEGOAK CREEK AS RELATED TO DISPOSAL OF LOW LEVEL
RADIOACTIVE LIQUID WASTES,

OBSTRUCTION TO FLOW GOODMAN V UNITED STATES (FEDERAL GOVERNMENT'S LIABILITY FOR FLOOD CAMAGE). W70-09473 04A

OCEAN CIRCULATION
CHEMICAL CHARACTERISTICS OF WATER MASSES IN THE ABERASIAN
BASIN OF THE ARCTIC QCEAN,
W70-09230
02K

OCEANOGRAFHY
USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING, W70-05029
07B

EFFECIS OF THERMAL DISCHARGE FROM THE SAN ONOFRE NUCLEAR GENERATING STATION, W70-09165

OCEANS
USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING, 07B W70-09029

ODOR CONTROL METHODS, EXPERIMENTATION AND APPLICATION, 870-09190 05D

ODOR CONTROL ODOR CONTROL METHODS, EXPERIMENTATION AND APPLICATION, W70-09190

ODOR CONTROL METHODS, EXPERIMENTATION AND APPLICATION, W70-09190 05D

HOPKINS W UPPER SCIOTO DRAINAGE AND CONSERVANCY DIST (NO LAMAGES FOR IMPROPER MAINTENANCE OF DRAINAGE DISTRICT'S

CIL WASTES
IN-PLANT WASTE REDUCTION,
W70-09316

TOXICITY STUDIES WITH AM OIL-SPILL EMULSIFIER AND THE GREEN ALGA PRASINOCLADUS MARINUS, 05C

PRELIMINARY RESULTS OF THE EXPERIMENTS ON THE TOXICITY OF OIL COUNTERACTING AGENT (ESSO COREXIT 7664), WITH AND WITHOUT IRAQ CRUDE OIL, FOR SELECTED MEMBERS OF MAFINE

OILY WATER HYDROCARBONS IN THERMAL AREAS, NORTHWESTERN WYOHING, W70-09108

THE EFFECT OF SALINITY ON THE OXIDATION OF HYDROCABBONS IN ESTUABINE ENVIRONMENTS, 05B

OKLAHONA EX REL PHILLIPS V GUY F ATKINSON CO (INJUNCTION AGAINST DAM CONSTRUCTION).
1070-09071

PLOOD PLAIN INFORMATION, COTTONWOOD CREEK, GUTHRIE,

ON-SITE INVESTIGATION
EFFECTS OF THERNAL DISCHARGE FROM THE SAN ONOFRE NUCLEAR
GENERATING STATION,
05C

ON-SITE TESTS
COMPARATIVE STUDY OF THE WATER BALANCE IN THE AERATED ZONES
WITH RALIO-ACTIVITE HETHODS AND WEIGHABLE LYSIMETER,
W70-09263
02G

DETERMINATION OF CAPILLARY CONDUCTIVITY AND DIFFUSIVITY OF

OPEN CHANNEL FLOW
SPILLWAY AND OUTLET WORKS, ROWLESBURG DAM, CHEAT BIVER, WEST
VIRGINIA HYDRAULIC MODEL INVESTIGATION.

TURBULENCE MEASUREMENTS BEAR THE FREE SURFACE OF AN OPEN

EFFECTS OF EFFLUENT AND INFLUENT SEEPAGE ON THE HIDRODYNAMIC FORCES ACTING ON AN IDEALIZED NONCOHESIVE SEDIMENT PARTICLE, 970-09410

NUTSIENTS

OFE-PAT	SUEJEC
STUDY OF EBOSION IN BOADSIDE DRAINAGE CE. CARCIINA, W70-05455 04.	
OFFERING CCSIS AN EVALUATION OF THE FROBLEMS OF SANITAR: 1ESICM, 870-09185	
CFEBATING FORCES CFEBATING FORCES ON SECTOR GATES UNDER RETERABLIC HODEL INVESTIGATION, W70-09177 08	EVERSE HEADS
OFTICAL INSTRUMENTS AN ELECTRO-OPTICAL PROBE FOR MEASUREMENT SEDIMENT CONCENTRATION, 870-09026 02	
OPTIMAL MANAGEMENT CETIMIZATION OF WATER RESOURCES SYSTEMS: FROJECTION AND THE CONJUGATE GRADIENT ME' W70-09092	THODS,
OFTIMIZATION APPLICATION OF SPECIALIZED OPTIMIZATION OF CUALITY AND QUANTITY MANAGEMENT WITH RESIDENT FINE TRINITY RIVER BASIN, W70-09094 050	PECT TO FLANNING FOF
THE OPTIMIZATION OF STORM-HOLDING TANKS FCILOTICS CONTECL, W70-09181 056	
CPTIMAL SESCURCE ALLOCATION AND SOME TEC	HNIOUES OF
CFTIMIZATION, W70-09182	
OPTIMUM DEVELOPMENT FLANS	
FIANNING OUE FUTURE WATER RESCURCES, W70-09153 06	В
CFEGON WATER BUDGET OF UPPER KLAMATH LAKE SOUTH	DESTERN CRECON
£70-09250 · 02	
ORGANIC MATTER THE REPROT OF BIOLOGICAL LIFE ON THE DISS CONCENTRATION IN THE DELAWARE RIVER, W70-09189 050	SOLVED OXYGEN
EFFECTS OF SALTS AND ORGANIC MATERIALS OF CONDUCTIVITY OF THE SOILS, W70-09290 026	
ORGANIC PESTICIDES A KINETIC AND EQUILIBRIUM STUDY OF THE AS GROANIC INSECTICIDES CARFARTL AND PARATE CEGANIC BATTER SURFACES, W70-05164 05.	ION UPON SOME SOIL
OFGANCLEFTIC PROPERTIES CDGF CONTROL HETBODS, EXPERIMENTATION AND W70-09190 05:	
OFIRNTED CORES CN GEOLOGICAL AND TECHNOLOGICAL ASPECTS OF DIAMONI DRILLING,	OF ORIENTED N-SIZE
\$70-09028 083	F
OSMOSIS A STUDY ON FRESSUBE MEMBBANE PROPERTIES : CAPILLARY CONDUCTIVITY MEASUREMENTS,	IN RELATION TO
W70-09279 020	G
OSMCTIC ADJUSTMENT EFFECT OF VARIATIONS IN SUBSTRATE SALINITED FOR AND ICHIC COMPOSITION OF BEAN IS, W70-09144 02:	AV FS,
MINERAL METABOLISM OF HALOPHYTES, 870-09147 02:	ı
OSBOTIC FFESSURE FFFECT OF VARIATIONS IN SUBSTRATE SALINT PALANCE AND IONIC COMPOSITION OF BEAU LE W70-09144	AVES,
BINEBAL BETABCLISH OF HALCPHYTES, N70-09147 02:	r
HEASUBEHENT OF WATER POTENTIAL AND CSHOT: SOIL WITH A COMBINED THERMOCOUPLE PSYCHRO SENSCE, W70-09364	OMETER AND SALINITY
OUTLET WOFKS SPILLWAY AND OUTLET WORKS, ROWLESBURG DAY VIRGINIA HYDRAULIC HODEL INVESTIGATION, W70-09160 08	M, CHEAT RIVER, WEST
OVERFLOW DAVIS V CITIES SERVICE OIL CO (LIABILITY EY CIL FOILUTION). W70-09243 06	

OVERVOLTAGE
TRABSIEST OVERVCITAGE ON A PIFCLAR HVDC OVERHEAL LIBE CAUSED
FY DC LIME FAULTS,
W70-09018
08C

```
CHMFRSBIF OF BEDS HONREIN W HONTICELLO (DEED TO LAKE FRONTAGE AS NCT EXTENDING CRMESSHIP TO LAKE BED).
   CARTER CIL CO V WATSON (BOUNDARY DISFUTE WHERE LAND CONVEY!Y
BORDEBED ON A STREAM).
W70-09077
   PIKE RAFIDS POWER CO V MINNEAPOLIS ST P AND S S M FY (BELATIVE RIGHTS TO RIVER BED AS BETWEEN BRIDGE OWNER AND DAM CWNER).

W70-09081
   ANDERSON V HOBBS TIE AND TIMBER CO (TITLE TO BRIDGE RESTINGUECO FIVER BED). W70-03159
   BLASK V SOWL (OWNERSHIP OF ISLANDS IN NAVIGABLE WATERS). W70-09175 06E
   UNITED STATES V ALASKA (RELATIVE RIGHTS IN SUBMERGED LAND)...
   BRANT LAKE SHORES, INC V BARTON (ADVERSE POSSESSION OF LAND! BELOW THE HIGH WATER MARK).
   BEARC'S ERIE BASIN V NEW YORK (RIGHTS TO COMPENSATION AWARD! BASED ON OWNERSHIP OF LANDS CONDENSED). W70-09463
   UNITED STATES V OTLEY (OWNERSHIP OF LAKE BEDS).
OXIDATION BASIS FOR TREATING POULTRY PLANT WASTES, , W70-09320 05D
    THE EFFECT OF SALINITY ON THE OXIDATION OF HYDROCAFFONS IN ESTUABINE ENVIRONMENTS, W70-09424 05B
OXIDATION LAGOONS
FORAGE CROP INRIGATION WITH OXIDATION POND EFFLUENT,
W70-09423 05D
   MICROBIOLOGY OF A WASTE STABILIZATION POND,
OXYGEN CONSUMPTION
PHYSIOLOGICAL RESPONSES TO TEMPERATURE AND DESICCATION IN
THE ENDEMIC NEW MEXICO PLETHODONTIDS, PLETHODON NECHEXICANUS:
AND AMEIORS HARDII,
W70-09145
021
OXYGEN SAG
THE EFFECT OF BIOLOGICAL LIPE ON THE DISSOLVED OXYGEN
CONCENTRATION IN THE DELAWARE RIVER,
W70-05189
050
OYSTER CCHTAMINATION
GIBSON V CITY OF TAMPA (FOILUTION OF CYSTER BEDS BY
UNIFIATED MUNICIPAL SEWAGE).
W70-09485
05B
   GIESON V CITY OF TAMPA (POLLUTION OF OYSTER BEDS BY UNTREATED MUNICIPAL SEWAGE). N70-09485
PACIFIC NORTHWEST U WATERSHED HUHAN-USE LEVEL AND WATER QUALITY, W70-09240. 05P
PADDY RATCONS
   PAEDY RATOONS,
W70-09501
PALECCLIMATOLOGY
REASONS FOR CLIMATIC CHANGES IN THE GEOLOGICAL FAST,
    W70-09102
   CLIMATIC OSCILLATIONS 1200-2000 A D, W70-09224
PAMPEAN SCILS
HYDROLOGICAL CONSTANTS OF PAMPEAN SOIIS BROWN PRAIRIE AND
BLACK FFAIRIE,
W70-05287
026
                                              02G
PARK MANAGEMENT
THE IMPORTANCE OF WATER RELATED ACTIVITIES AT STATE PARKS IN
MISSISSIPPI,
W70-09259
068
PARKS
THE IMPORTANCE OF WATER RELATED ACTIVITIES AT STATE PARKS IN MISSISSIPPI, W70-09259

06B
 PATENTS
THOMAS B BISHOP CO V SANTA BARBARA CCONTY (HEANDER LINES AS EQUINTARIES).
W70-09082
PATH OF FOLLUTANTS
COMPOSITION OF WATER IN CLINCH RIVER, TENNESSEE RIVER, AND
WHITEOAR CREEK AS RELATED TO DISPOSAL OF LCW LEVEL
RADIOACCIVE LIQUID WASTES,
058
```

SUEJECT INDEX PAT-1

USE OF TOPOLOGIC INFORMATION IN PROCESSING DATA FOR CHANNEL NETWORKS, 07C

07C

USERSION IN HOMOGENEOUS ESTUABLY FLOW, 02L

YMENT PERGER V OHISON (NO ABSOLUTE RIGHT TO TOLL FREE USE OF GOVERNMENT CONTROLLER DOCK). W70-05469

AR RIVER(MISS)
A SYSTEM APEROACH FOR THE STUDY AND CONTROL OF FACTORS
AFFECTING WATER FOLLUTION,
R70-09422

NNSYLVANIA ACKERMAN V TOWNSHIF OF NORTH HUNTINGDON (MUNICIPAL AUTHORITY TC GRANT BIGHTS IN FFIVATELY CWNED SEWER LINE). N70-09053

CITY OF PHILADELFHIA V STANDARD OIL CO (USE OF PUBLIC EULKHEAD BY RIPARIAN OWNER).

EFCCLATION
REDISINIBUTION OF MOISTURE AFTER INFILTRATION IN DRY SOILS.
INFLUENCE OF GEAVITY,
02G

A STUDY OF EEDISTRIBUTION AFTER THE FINISH OF HORIZONTAL INFILTRATION (FRENCH), 02G

EFFOFMANCE
FION CF ENTRAINED AIB IN CENTRIFUGAL PUMPS,
N70-09023 080

EFFECT OF RECIRCULATION ON DEEP TRICKLING FILTER PERFORMANCE, W70-09221 05D

THE STASONAL FEBFORMANCE AND THE PATTERNS OF CHEMICAL AND ELCLOCICAL EVENTS IN SEWAGE LAGOONS, \$70-05333

TREATMENT OF DAIRY MANDRE BY LAGCONING, W70-09335 05D

RETEREDAL NEEVES
TEMBERATURE-DEFENDENT CHARACTERISTICS OF PERIPHERAL NERVES
EXPOSED TO ITEREFERT THERMAL CONDITIONS IN THE SAME ANIMAL,
W70-09160
05C

FEMAFFICST
CHARACTERISTICS OF PERMAFROST AND OF THE ACTIVE LAYER IN
MEST SIEFFIA,
W70-09257
02C

GEOPHYSICAL STUDIES IN PERMAPROST REGIONS IN THE U.S.S.R., %70-05396

EMEAFILITY

FIDUCTION OF SELFAGE LOSSES FROM IBRIGATION CANALS AS A

FESUIT OF SILTING,

970-09043

THE DETERMINATION OF THE TRANSPORT COEFFICIENTS OF CELLULOSE ACETATE 4EMERANES, 03A 070-09357

a COMPACTION THEORY FOR MODIFIED REVERSE OSMOSIS MEMBRANĖS,

CCMEACTION OF CELLULOSE ACETATE MEMBRANES, N70-09359

SHITS
MIAMI BEACH JOCKEY CIUB, INC V DEBN (GOVERNMENT CONTROL OVER
CESTBUCTIONS TO NAVIGATION).

06E

CESTEDCTIONS TO NAVIGATION).

M70-09478

BEBMSELECTIVE MEMERANES

IESIGN AND CONSTRUCTION SYSTEM FOR THE DETERMINATION OF THANSPORT AND COMPACTION COEFFICIENTS OF REVERSE OSMOSIS BEMERANES.

WY0-09356

O3A

#70-09356 03A
A COMPACTION THEORY FOR MODIFIED REVERSE OSMOSIS MEMBRANES, W70-09358 03A

COMEACTION OF CHILDICSE ACETATE MEMERANES, 03A 03A

PESTICIDE KINETICS
A RIBETIC AND EQUILIPEIUM STUDY OF THE ADSORPTION OF THE CEGANIC INSECTICIDES CARBARYL AND PARATHION UPON SCHE SCIL GEGANIC HATTEE SURFACES,
W70-09184

PESTICIDES
EBOCEFOINGS WORKSHIP ON MOSQUITO CONTROL IN MORTH CAROLINA, . W70-09421

EHENOIS
RINETIC ASSECTS OF THE TREATHENT OF PHENOLIC WASTES, 05D 05D 05D

PHESPHATES

EPPECTIVE PHOSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE ACTIVATED SLUDGE PROCESS,

DETERGENTS, PHOSPHATES, AND WATER POLIUTION, W70-09388

PHOSPHCRUS

EFFECTIVE PHOSPHORUS REMOVAL BY THE ADDITION OF ALUE TO THE ACTIVATED SLUDGE PROCESS, W70-09186

05D

95D

A STATEMENT ON PHOSPHORUS, W70-09325

PHOSPHORUS REMOVAL WITH FERRIC IRON AND ALUMINUM, W70+09507 05D

PHOSPHCRUS COMPOUNDS

EFFECTIVE PHOSPHORUS REMOVAL BY THE ADDITION OF AIUM TO THE ACTIVATED SLUDGE PROCESS,

W70-09166

05D

PHOSEHCRUS REMOVAL

EFFECTIVE PHOSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE ACTIVATED SLUDGE PROCESS,

W70-09486

05D

PHOSPHORUS REMOVAL WITH FERRIC IRON AND ALUMINUM, W70-09507

PHYSIOLOGICAL ECOLOGY
PHYSIOLOGICAL RESPONSES TO TEMPERATURE AND DESICCATION IN
THE ENDIMIC NEW MEXICO PLETHODONTIDS, PLETHODON NECHEXICANUS
AND ANEIDES HARDII,
W70-09145

THE TERRESTRIAL ECOLOGY OF THE SPADEFCOT TOAD SCAFFIOFUS HAMMONEIL, 02G

HEART RATE AND CHANGES IN BODY FLUIDS IN AESTIVATING TOADS FROM MEDIC HABITATS, W70-09148

WATER ECONOMY OF THE GREEN-TAILED TOWNEE (CHLORURA CHICRURA), #70-09149 021

THE TEMFERATURE SELECTION OF SMALL HYPOPHYSECIOMIZED GOLDFISH, (CARASSIUS AUBATUS L.), W70-09151 05C

PILOT FIANT
CATTLE SKIN TANNERY WASTES TREATMENT IN A COMPLETELY MIXED ACTIVATED SLUDGE PILOT PLANT,
W70-09324
05D

PILOT PLANTS
TREATMENT OF DAIRY MANUFE BY LAGOONING,
W70-09335
05D

PIPE FICH
ZONE LENGTHS OF AIR EMULSION IN WATER DOWNSTREAM OF THE RING
JUMP IN PIPES,
W70-09022
08B

PIPE LININGS ABOUT THE ROUGHNESS PROBLEM IN PIPES AND TUNNELS, \$70-09011

PIPELINES
ACKERMAN V TOWNSHIP OF NORTH HUNTINGDON (MUNICIPAL AUTHORITY
TO GRANT RIGHTS IN PRIVATELY OWNED SEWER LINE).
W70-09053

PIPES
ABOUT THE ROUGHNESS PROBLEM IN PIPES AND TUNNELS,
W70-09011 08B

ZONE LENGTHS OF AIR EMULSION IN WATER DOWNSTREAM OF THE RING-JUMP IN PIPES, W70-09022

PLANNING ELECTRIC POWER - IMPACT ON THE ENVIRONMENT, W70-09020 06B

WATER QUALITY PLANNING AND MANAGEMENT (PLANNING BSSENTIAL TO INSUER RATER QUALITY), 05G

CHAPTER 2 INSTITUTE FOR ANALYTICAL STUDIES. W70-09440 06E

PLANT DISEASE
ALGAL CANCER AND CAUSAL SUBSTANCES IN WASTES FROM THE COAL CHEMICAL INDUSTRY,
H70-09437

PLANT FATHOLOGY
TOXICITY STUDIES WITH AN OIL-SPILL EMULSIPIER AND THE GREEN ALGA PRASINOCLADUS MARINUS,
W70-09429
05C

PLANT PHYSIOLOGY
THE STABILITY OF WHEAT EMBRYO GLUTAMATE DECARBOXYLASE UNDER CONDITIONS OF WATER STRESS,
021

PLASTICS

CHEMICAL INDUSTRY,

ADVANCES IN HANCLING GAS CHICFINE, W7C-09319 05D
FLEISTCCENE FFOCE BRASONS FOR CLIMATIC CHANGES IN THE GEOLOGICAL PAST, WTC-09102 02F
PIONE EDOVANT ELUKES AND THERMALS, N70~09168 05B
POINT DILUTION TEACER METHODS VALIDITY CONDITIONS OF THE POINT DILUTION METHOD, W70-09284 OZF
POLISH ISOTOPE APPARATUS FOR RESEARCH ON SOIL MOISTURE, \$70-09271 07E
POILUTION ABATEMENT SPACE HEATING IN URBAN ENVIRONMENTS, W70-09152 08C
USES OF WASTE HEAT,
FUROFEAN WASTE WATER MANAGEMENT ALD RESEARCH,
W70-09322 05D
POLYMER FOLYMER PLUS MAGNETIC FIELD USED TO TREAT PARAMAGNETIC SIURBIES, N70-09318 05D
PODDS ELEMENTS OF THE WATER BALANCE OF SMALL RESERVOIRS OF THE CENTEAL CHEENCZEM FREVINCES,
¥70-09314 02H
THE EALANCE METHOD OF COMPUTING SEDIMENT FLOW AND ESTIMATING 188 - RATE OF SILTING OF RESERVOIRS, 870-09315
TAP OF EVAPORATION FROM SMAIL RESERVOIRS OF THE CENTRAL CHERROZEM FFOVINCES, N70-09413
SMALL BESERVOIRS AND PONDS OF THE CENTRAL CHERNOZEM
FECUINCES, ESFSE, N70-09415 04A
CHARACTERISTICS OF SILTING OF SMALL RESERVOIRS OF THE
CENTRAL CHESHOZEM PROVINCES AND COMPUTATION OF DENSITY OF FOTICH CEPOSITS, N70-09417
IEVELOPING A METHOD OF COMPUTING SILTING OF SMALL RESERVOIRS IN THE CENTRAL CHERNOZEM PROVINCES,
₩70-09418 0°2J
EYDROCHEMICAL CHARACTERISTICS OF SHALL BESERVOIRS IN SOME LISTRICTS OF THE CENTRAL CHERNOZEM PROVINCES, 870-09419
PCFDIATICE CONTROL
ELAT WASTE, W70-05162 05E
ECFE FRESSURE
SOLL MOISTURE PRESSURE IN SOME CLIMATIC ZONES, 670-09291
FORE SIZE TETERMINATION OF PORE SIZE BY THE AIR BURBLING PRESSURE REIDCD,
N70-09257 07E
THE RELATION BETWEEN PARTICLE SIZE, PORE SIZE AND HYDRAULIC CONDUCTIVITY OF SAND SPPARATES, 02G
PCECSITY
DETERMINATION OF PORE SIZE BY THE AIR BUEBLING PRESSURE FETECL, 870-09257
7.0
THE RELATION BETWEEN PARTICLE SIZE, PORE SIZE AND HYDRAULIC CONDUCTIVITY OF SAND SEFABATES, U70-09298
PODCUS HECIA 180-DIMENSICNAL DISFERSION EXPERIMENTS IN A POROUS HEDIUM, 870-09123 02F
TEE TERFE-PEASE DOMAIN IN HYDROLOGY, N70-09260 02F
INTERMINATION OF PORE SIZE BY THE AIR BUBBLING PRESSURE BETBOD, 870-09257
THE RELATION BETWEEN FARTICLE SIZE, PORE SIZE AND HYDRAULIC CONDUCTIVITY OF SAND SEPARATES, W70-05298 02G
PCFCUS MELLIA FILTER RADIOTRACER STUDIES ON RAPID SAND FILTMATION.
N/U-09051 05P
ALGAL CANCED AND CAUSAL SUBSTANCES IN WASTES PROM THE COAL

```
THE EFFECT OF SOIL HOISTURE LEVEL OF THE INCIDENCE OF EARLY
BLIGHT ON POTATO AND TOMATO PLANTS,
870-09137
POTENTIAL EVAPORATION
THE BOLE OF VEGETATION IN SOIL WATER FROPLEMS,
W70-09262
021
POULTRY
   BAFFLED BIOLOGICAL BASIS FOR TREATING POULTRY PLANT WASTES,
POWES OFFRATION AND MAINTENANCE
BURLEY IRRIGATION DIST V ICKES (RIGHTS TO PROFIT FACE DAM
OPERATICE).
W70-09472
POWERPLANTS
SPACE HEATING IN URBAN ENVIRONMENTS, W70-09192
   USES OF WASTE HEAT,
W70-09193
PRAIRIE SCILS
HYDROLOGICAL CONSTANTS OF PAMPEAN SCILS BROWN PRAIRIE AND
   BLACK FRAIRIE,
PRECIPITATION GAGES
EXPERIENCES WITH SHOW PILLOWS IN NORWAY,
02C
PRECIPITATION (ATMOSPHERIC)
INFLUENCE OF EVAPORATION FROM LAKE BAIKAL ON PRECIPITATION
IN THE SURROUNDING REGIONS,
02D
   MICRCELEMENTS IN ATMOSPHERIC PRECIPITATION IN THE OTRAZHENSKIY RESERVOIR ABEA, W70-09099 02B
   INDIRECT METHOD FOR COMPUTING THE DURATION OF PRECIPITATION,
   A SELECTED AWNOTATED BIBLIOGRAPHY OF ENVIRONMENTAL STUDIES OF POLAND, W70-09456
PREFERENCES (WATER RIGHTS)
NIACARA FALLS POWER CO V DURYEA (RIGHT OF STATE TO CHARGE FOR WATER USE).
W70-09063
06E
   ALBION-IDAHO LAND CO V MAT IRRIGATION CC (PRORATION OF SATER RIGHTS UNDER PRIOR APPROPRIATION DOCTORNE). W7Q-09474
   ICKES V POI (PROTECTION OF PRIVATE AFFROPRIATION FIGPTS IN AU
FELERAL RECLAMATION PROJECT).
W70-09479 06E
PRESSURE HEAD
AN APPROXIMATE METHOD FOR DETERMINING THE HYDRAULIC COMBOCITYITY FUNCTION OF UNSATURATED SOIL, W70-09342 02G
PPIHARY PRODUCTIVITY
WATER QUALITY IN RELATION TO PRODUCTIVITY OF LAKE ASHTABULA
BESERVOIR IN SOUTHEASTERN MORTH DAKOTA,
500
PRIOR AFPROPRIATION
HINDFHLYDER V LA PLATA RIVER AND CHERFY CREEK DITCH CO
(EQUITABLE APPOBLIONNENT OF INTERSTATE STREAM THROUGH USE OF F
INTERSTATE COMPACT).
W70-05065
C6E
   UNITED STATES V WALKER RIVER IRRIGATION DIST (RIGHT TO USE OF STREAM BASED ON PRIOR APPROPRIATION). W70-09174
   MEBRASKA V WIGHING (APPORTIONMENT OF INTERSTATE WAIFRS UNDER PRIOF AFROPRIATION).
W70-09461 RIAMONO.
   ALEIGH-IDAHO LAND CO W MAF IRRIGATION CO (PROPATION OF WATER
RIGHTS UNDER PRIOR APPROPRIATION DOUTERNE).
W70-09474
   ALBION-IDAHO LAND CO W MAF IRRIGATION CO (PRORATION OF WATER RIGHTS UNDER PRIOR APPROPRIATION DOCTEINE). 870-09474 06E
PROCESS CONDITIONS
COMPARISON OF AERATION EFFICIENCY UNDER PROCESS CONDITIONS,
W70-09510
05D
PROCESS MCDIFICATION
IN-PLANT WASTE REDUCTION,
W70-09316
PRODUCTIVITY
POLLUTION OF ESTUARIES,
N70-09383
```

05C

SUBJECT INDEX

RCFILES
ISOPACHCUS EAFFING OF THE LCHER PATUXENT ESTUARY SECIMENTS
EY CONTINUOUS SEISMIC PROFILING TECHNIQUES, FCJECTS

BESEARCH ON WATER QUALITY,

W70-09348 094 REPORT OF WATER RESOURCES RESEARCH, JULY 1, 1968 - JUNE 30, 090

FFTERSON V UNITED STATES (PUBLIC WORK INCLUDES FLOOD CONTROL AND IMPROVEDENTS TO NAVIATION). 04A

ATBICH-IDARC LAND CO V NAF IRRIGATION CO (PROBATION OF WATER BIGHTS UNDER FRIOR AFPROPRIATION DOCTRINE). 670-09474

FUELIC BEAUTH THE 'ITAL-ITAL' DISEASE AND THE POLIUTION OF SIVER WATER BY CARBIUS FROM A MINE, 05C

AIGAL CABCEF AND CAUSAL SUBSTANCES IN WASTES FROM THE COAL CHEMICAL INDUSTRY, W70-09437

PUBLIC LANDS
UNITED STATES EX REL SIERRA LAND AND WATER CO V ICKES
(GOVERBEIT GRANTS OF RIGHTS-OF-WAY OVER PUBLIC LANDS FOR
HRICATION SYSTEMS).
W70-C94E0
03F

PUBLIC PCLICY
CHAPTER 2
W70-09440
INSTITUTE FOR ANALYTICAL STUDIES.
06E

FULLIC RIGHTS
HIAGARA FALLS POWER CO W DURYEA (RIGHT OF STATE TO CHARGE FOR WALLE USE). 068

EE-BC-SHOME ASS'E, IMC V HOGARTH (FUBLIC FISHING RIGHTS IN NAVIGABLE RIVERS). 870-05066

PUBLIC UTILITIES
CLSEN V CITY OF DEARBORN (EVALUATION OF PROPERTY PARTIALLY
TAKEN FOR FUBLIC UTILITY FUBLOSES).
H70-09491

PUELIC WOFK
EFFESON W UNITED STATES (PUELIC WORK INCLUDES FLOOD CONTROL
AND IMPROVEMENTS TO NAVIATION).
04A
00471

FUEFIC RICC V RUSSELL AND CO (IMPOSED TAX AS IMPAIRMENT OF CCHIRACT FOR WATER SUPPLY).

06E

POLF AND FAFFS INCUSTRY
BOD AND COLCE REMOVAL FROM KRAFT MILL WASTES,
W70-09330

PUMF TUREINES
FAPID REVERSAL OF SAW LUIS PUMFING-GENERATING UNITS,
W70-09024
08C

EUPEING

EAY ISIAND CRAINAGE AND LEVEE DIST NO 1 V NUSSBAUK
(CPERATION COSTS OF FUMPING FACILITY).

06C

070-09155

FURES
FICH OF ENTERINED AIR IN CENTEIFUGAL PUMPS,
100-09023
080

FURF-GENERATORS

5APID REVERSAL OF SAN LUIS PUMPING-GENERATING UNITS,
W70-09034

08C

RATIO INTERFERENCE CALCULATION OF RADIC NCISE LEVEL FOR THE DESIGN OF AC POWER TRANSMISSION LINES, 970-090:8

BALIGACTIVE DATING
AGE OF GUATERNARY SEDIMENTS AND SOILS IN THE SACRAMENTO
AREA, CALIFORNIA BY DRAWIDH AND ACTIVITY SERIES DATING OF
VERTERATE FOSSILS,

02J

BATIOACTIVE TRACERS
USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING,
W70-09029
07E

FADIOTRACER STUDIES ON RAPID SAND FILTRATION, U7C-09091

USE CF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING, 870-09029 07B

NUCLEAR TECHNIQUES IN HYDROLOGICAL INVESTIGATIONS IN THE UNSATURATED ZONE, W70-09272 07B

RAILROAD RELOCATION
PETERSON W UNITED STATES (PUBLIC WORK INCLUDES FLCCP CONTROL
AND IMPROVEMENTS TO NAVIATION).
04A

RAINFALL MIGRATION OF SOLUBLE SALTS IN AN IRRIGATED FIELD IN RELATION TO BAINFALL AND IRRIGATION, 03C

INFILTRATION IN TERMS OF SOIL MOISTURE, RAIN INTENSITY AND DETTH OF RAINFALL, #70-09301

RAINFALL-RUNOFF RELATIONSHIPS

EFFECTS OF FOREST CLEAR-FELLING ON THE STORM HYDROGRAPH,

W70-09117

03B

PLANT COVER, RUNOFF, AND SEDIMENT YIELD RELATIONSHIPS ON MANCOS SHALE IN WESTERN COLORADO, 02J

PLOODS IN IOWA, W70-09254 02E

HYDROLOGICAL ANALYSIS OF VOLCANIC TERRANE LOWER PASIN OF THE RIO GRANDE DE SAN HIGUEL, EL SALVADOR, W70-09370

INFLUENCE OF RAINFALL EMERGY ON SOIL LOSS AND INFILTRATION RATES 2. EFFECT OF CLOD SIZE DISTRIBUTION, W70-09378

RAPID BEVERSAL RAPID REVERSAL OF SAN LUIS PUMPING-GENERATING UNITS, W70-09024 OPC

RAPID SAND FILTERS
RADIOTRACER STUDIES ON BAFID SAND FILTRATION,
W70-09091 05F

RATE CONSTANT
CHARACTERISTICS OF WASTEWATER AT DELHI,
W70-09327
05D

RATE OF INFILTRATION.
ON USING A TIME VARIABLE IMPILTRATION WITH THE ISPAELSON BORDER IRRIGATION EQUATION,
W70-09141
03F

REACHES (DISTANCE)
ZONE LENGTHS OF AIR EMULSION IN WATER DOWNSTREAM OF THE RING
JUMP IN PIPES,
W70-09022
00B

REAL PROPERTY BURAS V ELLZEY (POSSESSORY RIGHTS IN WATERFRONT PROPERTY) -W70-09323

RECIRCULATION ON DEEP TRICKLING FILTER
PERFORMANCE, 05D

RECLAIMED WATER
UNIVERSITY ROLE IN ASTRONAUT LIFE SUFFORT SYSTEMS WATER
RECOVERY SYSTEMS.
970-09236
05D

RECREATION TIME ELAS IN RECREATION BENEFIT ESTIMATES, OGA

THE IMPORTANCE OF WATER RELATED ACTIVITIES AT STATE PARKS IN

RED FIVER OKLAHOMA EX REL PHILLIPS V GUY F ATKINSON CO (INJUNCTION AGAINST DAM CONSTRUCTION). 06E 970-09071

REDUCTION OF SEEPAGE LOSSES FROM IRRIGATION CANALS AS A RESULT OF SILTING, W70-09043

IN-PLANT WASTE REDUCTION, W70-09316

REFINERY
IN-PLANT WASTE REDUCTION,
W70-09316

REGRESSION ANALYSIS
APPLICATION OF REGRESSION ANALYSIS IN HYDROLOGY,
W70-09391.

AN ANALYTICAL METHOD FOR EVALUATING THE SUSCEPTIBILITY OF FISH SPECIES TO AN AGRICULTURAL CHEMICAL (JAPANESE), 870-09433

RELATIVE RIGHTS
VERDE RIVER IRRIGATION AND POWER DIST V SALT RIVER VALLEY

WATER USERS* ASS*N (CONTRACTUAL RIGHTS TO DAMSITE).

RELATIVE WATER CONTENT

EFFECT OF VARIATIONS IN SUBSTRATE SALINITY ON THE WATER
FALANCE AND ICNIC COMPOSITION OF BEAN LEAVES,
W70-09144

OZI

RELIABILITY MAJOR ELECTFIC FOWEF FACILITIES AND THE ENVIRONMENT, W70-09048 OGG

REMEDIES ICKES V FOX (INCREASED WATER RATES IMPOSED CONTRARY TO LAW). W70-09067

ERIF LACKAWANNA BY V SILLS (SUNKEN VESSEL OBSTRUCTING DOCKS AS TRESEASS).

06F

REMOTE SENSING
MCMTHLY MEAN SURFACE TEMEERATURES FOR LAKE ONTARIO AS
LETERMINED EY AERIAL SURVEY,
E70-09206 02H

STUCY OF THE USE OF ABBIAL AND SATELLITE PHOTOGRAMMETRY FOR SURVEYS IS BYDECICGY, 07B

REFAIRING
CONTROL AND REFAIR OF CHACKS IN CONCRETE DAMS,
W70-09019
08F

FAYNE V MISSOUBL VALLEY DRAINAGE DIST NO 1 (CONSTRUCTION OF NEW SETTLING EASIN AS REPAIR OF OLD BASIN). %70-09490 04D

RESEARCH AND LEVELOPMENT
DISTILLATION DIGEST VOLUMES 1 AND 2.
870-09360 03A

CHAPTER 5 NATIONAL LABORATORY FOR ENVIRONMENTAL SCIENCE. W70-09443 06E

RESEARCH FACILITIES
UNIVERSITY BOIF IN ASTRONAUT LIFE SUPPORT SYSTEM: WATER
BECOVERY SYSTEMS,
W70-09236
05D

FUROPEAN WASTE WATER MANAGEMENT AND RESEARCH,

BESEARCH ON WATER QUALITY, W70-09348

09 À

CHAPTER 5 NATIONAL LABORATORY FOR ENVIRONMENTAL SCIENCE. W70-09443 06E

RESERVCIE CONSTRUCTION
SMALL RESERVOIRS AND PONES OF THE CENTRAL CHERNOZEM
FROVINCES, ESPSB,
W7G-09415
04A

FESERVCIE EVAFORATION

INTERCY RELATIONSHIPS IN THE DESIGN OF FLOATING COVERS FOR
EVAPORABICN EEDUCTION,
W70-09112

02D

BESERVOIR LEAKAGE IN LIMESTONE TERRAINS, W70-09042 04A

FREDICTIONS OF FESERVCIR LEAKAGE, W70-09046 02

IEAKAGE THROUGH EURIED CHANNELS, W70-09049 04A

RESERVCIR CRESATION
INLAND POWER AND LIGHT CO V GRIEGER (FLOOD DAMAGE PROM BEGLIGEST DAM CFERATION).
W70-09476

BESERVOIR SILTING WATER BALANCE AND SILTING OF SMALL RESERVOIRS IN THE CENTRAL CHERNOZEM OF THE BUSSIAN SOVIET FEDERAL SOCIALIST REPUBLIC. 670-09312

FESEBVOIR LEAKAGE IN LIMESTONE TERRAINS, W70-09042 04A

RESERVOIS SURVEYS
PRELICTIONS OF BESERVOIR LEAKAGE,
W7C-09046 02F

FESEBUCIR VIEID
A TWC-SIEF EROBABILISTIC MODEL OF STORAGE RESERVOIR WITH CORBELATED INPUTS,
W70-09116
06A

RESERVOIS LEAKAGE IN LINESTONE TERRAINS, H70-09042 04A

FREDICTIONS OF FESERVOIR LEAKAGE, W70-09046 02F

CHEBICAL COMPOSITION OF THE ICE OF OTKAZNEWSKIY BESERVCIE, 870-09097 02K

EYERCCHEMICAL REGIME AND SALT BALANCE OF OTKAZNENSKIY
RESEFVOIB IN THE FIRST YEAR OF ITS EXISTENCE (1966),
870-09098

RESERVOIR EFFECT ON DOWNSTREAM WATER TEMPERATURES IN THE UPPER DELAWARE RIVER BASIN, W70-09171 05a

ELEMENTS OF THE WATER BALANCE OF SHALL RESERVOIRS OF THE CENTRAL CHERNOZEM PROVINCES, W70-09314

THE BALANCE METHOD OF COMFUTING SECTIMENT FLOW AND ESTIMATING THE BACE OF SILTING OF RESERVOIRS, 02J

MAP CT EVAPORATION FROM SHALL RESERVOIRS OF TEE CENTRAL CHERNOZEM PROVINCES, W70-09413

WATER EROSION, THE FORNING OF SEDIMENT FLOW OF SMALL STREAMS! IN THE CENTRAL CHERNOZEM PROVINCES AND MEASURES FOR PROTECTING RESERVOIRS FROM SILTING, U2J

SMALL RESERVOIRS AND PONDS OF THE CENTRAL CHERNOZIE PROVINCES, RSPSR, W70-09415

CHARACTERISTICS OF SILTING OF SMALL FESERVOIRS OF THE CENTRAL CHERNOZEM PROVINCES AND COMPUTATION OF DENSITY OF BOTTOM DEFOSITS, M70-09417 02J

DEVELOPING A METHOD OF COMPUTING SILTING OF SMALL FESPPVOIRS IN THE CENTRAL CHERNOZEM PROVINCES, W70-09418

HYDROCHEMICAL CHARACTERISTICS OF SHALL RESERVCIRS IN SOME DISTRICTS OF THE CENTRAL CHERNOZEM FROVINCES, W70-09419 02K

RESINS

CONTINUOUS COUNTERCURRENT ION EXCHANGE.

W70-09037

05P

RESISTANCE EFFECT OF TEMPERATURE SHOCK ON THE TEMPERATURE RESISTANCE OF POINTLCTHERM AQUATIC ANTHALS. EXPERISENTS ON THE PROBLEM OF HEAT AND COLD-HARDENING IN ANIMALS (GERMAN), 170-05126

RESOURCE ALLOCATION
OPTIMAL RESOURCE ALLOCATION AND SOME TECHNIQUES OF
OPTIMIZATION,
W70-09162
05G

RESPIRATION
AUTOMATED ACTIVATED SLUDGE PLANTS WITH RESPIRATORY
METAPOLISM CONTROL,
W70-09502
05D

RETENTION
INPRARED SPECTROPHOTOMETRIC STUDY OF WET CLAY SOILS
(FRENCH),

THE NATURE OF THE MINIMAL WATER RETENTIVE CAPACITY, w70-09302 02G

PLOOD SERIES FOR GAGED PENNSYLVANIA SIRFAMS, W70-09420 02E

REVEBSE OSMOSIS
FINAL REPORT ON REVERSE OSMOSIS MEMPFANES CONTAINING
GRAFHITIC OXIDE,
470-09245
03A

IMPROVEHENT OF TUBULAR CELLULOSE ACETATE MEMBRANES BY FEED ADDITIVES, W70-03248

DESIGN AND CONSTRUCTION SYSTEM FOR THE DETERMINATION OF TRANSPORT AND COMPACTION COEFFICIENTS OF REVERSE OSMOSIS MEMBRANES, W70-09356

THE DETERMINATION OF THE TRANSPORT COEFFICIENTS OF CELLULOSE ACETATE MEMBRANES, W70-09357

A COMPACTION THEORY FOR MODIFIED REVERSE OSMOSIS MEMBERANES, W70-09358

COMPACTION OF CELLULOSE ACETATE MEMBRANES, N70-09359

DEVELOPMENT OF REVERSE OSMOSIS MEMBRANES, W70-09362

ENGINEERING AND ECONOMIC EVALUATION STUDY OF REVERSE OSMOSIS, 03A

REVERSIBLE TURBINES
RAPID REVERSAL OF SAN LUIS PUMPING-GENERATING UNITS,
#70-09034 08C

REVIEWS
SUMMARY OF GROUNDWATER OCCURRENCE IN CALIFORNIA,

SUBJECT INDEX 02F ¥70-09214 WATER TECHNOLOGY, #70-09361 03A E-EMERGENCE OF LANDS DICKSON V SANDEFUR (DISPUTED CWNERSHIP OF LAND APPEARING AFTER SUDDEN SBIFT IN RIVER'S COURSE). #70-09060 THE PHYSICS OF GLACIERS, W70-09412 020 IGBT-CF-WAY
UNITED STATES V WABASHA-NELSON BRIDGE CO (COMFENSATION FOR
CONSEQUENTIAL LAMAGES TO CONCENNEE RIGHT-OF-WAY).
W7C-09084
06E FALM EEACH COUNTY V SOUTH FIORIDA CONSERVANCY DIST (DRAINAGE DISTRICT'S USE OF LEVRE FOR CONSERVATION PARAMOUNT TO COUNTY'S USE AS A PUBLIC ROAD).

#70-09987 ANDERSON W HOBBS TIE AND TIMEER CO (TITLE TO BRIDGE RESTING UPON FIVER FED). NOO-03159 UNITED STATES EX FEI SIEBRA LAND AND WATER CO V ICKFS (GOVERNMENT GRANTS OF RIGHTS-CF-WAY OVER PUBLIC LANDS FOR IRRIGATION SYSTEMS). RICID STRUCTURES

LATERAL PRESSURES ON BIGID PERMANENT STRUCTURES,

W70-09045 EING JUME
ZONE LENGTHS OF AIR EMULSION IN WATER DOWNSTREAM OF THE RING
JUMF IN FIFES,
W70-09022
08E RIEARIAN LANDS
ELISS V KINSEY (EXTENSION OF ECUNDARY LINES FROM MEANDER
TIME TO SHOUE LINE).
06E BITABIAN SIGHTS
UNITED STATES V WILLOW RIVER FOWER CC (IMPAISED EFFICIENCY
OF HYDROELECTRIC FLANT CAUSED BY RAISING THE WATER LEVEL OF
THE BIVER ON WHICH IT WAS LOCATED).
W7C-09073

OGE IN FE CITY OF NEW YORK (RIGHTS OF OWNERS OF BEDS SUBSERVIENT TO UPLAND CHNEF'S RIFARIAN EIGHTS). RIVERS
TURBIDITY OF RIVERS AND ITS DISTRIBUTION IN THE CENTRAL
CHEBROZEM FROVINCES,
W70-09416
O2J EEHRENS V CITY OF MINNEAFOLIS (PUBLIC PUBPOSE REQUIPEMENT FOR CHANNEL IMPROVEMENT). 06E BCAL CONSTRUCTION STUDY OF EROSION IN BOADSIDE DRAINAGE CHANNELS IN NORTH CABCLINA, 970-05455 ROADEANKS
RHECLOGICAL AND ULTIMATE STRENGTH PROPERTIES OF COHESIVE RCALS
ELECTRONIC COMPUTER PROGRAM FOR HYDRAULIC ANALYSIS OF BOX
CUIVERIS (BEB EECGEAH BY-3), 08A
H70-09445 BOALSIDE DRAINAGE STUDY OF EECSION IN ECADSIDE DRAINAGE CHANNELS IN NORTH CAFCIINA, W70-09455 ROLGHNESS CCEFFICIENT ABOUT THE ROUGHNESS FROBLEM IN PIPES AND TUNNELS, W70-09011 ROUGHNESS (HYDFAULIC)

AEOUT THE ROUGHNESS PROBLEM IN PIPES AND TUNNELS,

870-09011 BCWIESFURG DAM SPILLWAY AND OUTLET WORKS, ROWLESBURG DAM, CHEAT RIVER, WEST VIRGINIA HYDRAULIC MODEL INVESTIGATION, W70-C9180

RUKCFF
INPLUENCE OF MAINFAIL ENERGY ON SOIL LOSS AND INFILTRATION
RATES 2. REFECT OF CLOD SIZE DISTRIBUTION,
RT0-09378
026 STUDY OF ERCSION IN ECADSIDE DRAINAGE CHANNELS IN NORTH CAROLLAR, 04A W70-09455 RUNCFF FORECASTING
IEEPARATORY REPORT OF THE TECHNICAL SUBCOMMITTEE ON SNOW.
W70-09351

A FREDICTION EQUATION FOR VEGETATION EFFECTS ON WATER YIELD FROM WATERSHEDS IN ARID AREAS, W70-09381 SAFETY ADVANCES IN HANDLING GAS CHLORINE, 05D W70-09319 LEARABLE NO PHYSIOLOGICAL RESPONSES TO TEMPERATURE AND DESICCATION IN THE ENDEMIC NEW MEXICO PLETHODONTIDS, PLETHODON NECHEXICAMUS AND AREIDES HARDLI, 021 SALINE SOILS EXPERIMENT IN THE LEACHING OF SALINE LAND IN SOUTHERN SALINE WATER INTRUSION
A NUMERICAL TECHNIQUE FOR CALCULATING THE TRANSIENT POSITION
OF THE SALTWATER FRONT,
W70-09196
02L SALINE WATER-FRESHWATER INTERFACES
ELECTROMAGNETIC ARRIAL SURVEY OF A FRESH WATER-SALI WATER
CONTACT IN THE RHONE DELTA (FRENCH),
07B MIGRATION OF SOLUBLE SALTS IN AW IRRIGATED FIELD IN RELATION TO RAINFALL AND IRRIGATION, 030 EFFECT OF TEMPERATURE AND SALINITY ON THE HEAT TOLERANCE IN THE BERMIT CRAB, DIOGENES BICRISTIMANUS, 970-09166 THE EFFECT OF SALINITY ON THE OXIDATION OF HYDROCAEBONS IN ESTUABLINE ENVIRONMENTS, U70-05424 SALMON
TEMPERATURE, REPRODUCTION AND BEHAVIOR,
05C W70-09170 HYDROCHEMICAL REGIME AND SALT BALANCE OF OTKAZNENSKIY RESERVOIR IN THE PIRST YEAR OF ITS EXISTENCE (1966), W70-09098 LT TOLERANCE
EFFECT OF VARIATIONS IN SUBSTRATE SALINITY ON THE WATER
BALANCE AND IONIC COMPOSITION OF FRAN LEAVES,
W70-09144
O21 MINERAL METABOLISM OF HALCPHYTES, 970-09147 SAMPLING
A SYSTEM FOR MEASURING TOTAL SEDIMENT YIELD FROM SMALL WATERSHEDS,
02J STREAM ORDER AS A MEASURE OF SAMPLE SOURCE UNCERTAINTY, W70-09202 SOME METHODS FOR THE DETERMINATION OF SOIL MOISTURP AND BALANCE MEASURING, 970-09270 BOD MASS BALANCE AND WATER QUALITY STANDARDS, W70-09349 05A SAN FRANCISCO BAY SOME EFFECTS OF FRESH-WATER INFLOW ON THE FIUSHING OF SOUTH SAN FRANCISCO BAY A PRELIMINARY REPORT, 05G BOVEMENT OF SEABED DRIFTERS IN THE SAN FRANCISCO BAY ESTUARY AND THE ADJACENT PACIFIC OCEAN A PRELIMINARY REPORT, W70-09216 SAN LUIS PUMPING-GENERATING RAPIC BEVERSAL OF SAN LUIS PUMPING-GENERATING UNITS, 08C W70-09034 SAND BARS
COMPUTATION OF THE DEFORMATION OF BARS AND NAVIGATION
CHANNELS,
W70-09256
02J SAND WAVES
COMPUTATION OF THE DEFORMATION OF BARS AND NAVIGATION CHANNELS, W70-09256 HYSTERESIS IN TWO SANDS AND THE INDEPENDENT DOMAIN MODEL, THE RELATION BETWEEN PARTICLE SIZE, FCRE SIZE AND EYDRAULIC CONDUCTIVITY OF SAND SEPARATES, 02G 970-09298 SANITARY ENGINEERING
AN EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM
DESIEN, 08A
W70-09185

SUBS	3
SAK-SET SUID	
SANITABY SEWERS AN EVALUATION OF THE ERCBLEMS OF SANITARY SEWER SYSTEM	
DESIGN, W70~09185 08A	
SASKATCHERAN (CANAEA) EFFECT OF SCIL PROFILE TYPE AND FERTILIZER ON MOISTURE USE	
EY WHEAT GROWN ON PALICH OF STUEELE LAND, W70-09139 03F	
SATURATED FLOW A MOVING BOUNDARY MODEL OF A ONE-DIMENSIONAL SATURATED-	
UNSATURATED, TRANSIENT POROUS FLOW SYSTEM, W70-09199 02G	
THE THREE-PEASE COMAIN IN HYDROLOGY, W70-C9260 02F	
SCENIC FASEMENTS	
IN RE EAST FIVER DRIVE (VALUATION OF SCENIC EASEMENTS IN CONDERNATION PROCEEDINGS).	
₩7C-09C€2 06E	
SEA WATER	
SUPPRISION, CONSTRUCTION AND EVALUATION OF A SEA WATER LESULFATING PROCESS PILOT PLANT,	
W70-09354 . 03A	
SEASONAL	
THE SEASONAL PERFORMANCE AND THE PATTERNS OF CHEMICAL AND FICICCICAL EVENTS IN SENAGE LAGOONS.	
W70-09333 05D	
SECONDARY TREATMENT EFFECT OF RECIRCULATION ON DEEP TRICKLING FIITER	
FERFORMANCE,	
W70-09321 05D	
SECTOR GATES OPERATING FORCES ON SECTOR GATES UNDER REVERSE HEADS	
EXIPADIIC MCDEL INVESTIGATION,	
R70-09177 08E	
SELIMENT CONTFOL WATER EROSICH, THE FORMING OF SEDIMENT FLOW OF SMALL STREAMS	
IN THE CENTRAL CHERNOZEM PROVINCES AND MEASURES FOR	
ERCTECTING FESSERVOIRS FROM SILTING, E70-09414 02J	
CITY OF PHILADELPHIA V STANDARD OIL CO (USE OF PUBLIC EULKHEAD BY BIFASIAN CHNES).	
W70-09483 04A	
SEDIMENT DISCHAFGE	
RESEARCE NEEDS OF THERMAL AND SEDIMENTARY POLLUTION IN TIDAL GATERS.	
W70-09167 05B	
SECIMENT ICAD	
AN ELECTBO-CPTICAL PECER FOR MEASUREMENT OF SUSPENDED SEDIMENT CONCENTRATION,	
W70-09026 02J	
THE EFFECT OF BEC-LCAD HOVEMENT ON THE VELOCITY DISTRIBUTION OF FICW.	
W70-09052 02J	
A SYSTEM FOR MEASURING TOTAL SEDIMENT YIELD PROM SMALL	
WATERSHELS W70-09121 02J	
SECIMENT IBANSPORT	
TRACED STRUTES OF THE MOUPHERS OF CARD AND CRASES	

870-09024

USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING, W70-09029 07B

FIUME STUDIES OF THE SECIMENT TRANSFER COEFFICIENT, 870-09119

A SUMMARY OF PERLIMINARY STUDIES OF SEDIMENTATION AND BIDDROLOGY IN BOILMAS LAGCON, MARIN COUNTY, CALIFORNIA, \$70-09235

PLANT COVER, RUNCFF, AND SEDIMENT YIELD RELATIONSHIPS ON HANCOS SEALE IN WESTERN COLCEAGE, 02J

A SYSTEM FOR MEASURING TOTAL SEDIMENT VIELD FROM SMALL

NEW YORK BETROPOLITAN REGION--A MAJOE SEDIMENT SOURCE. 02J 02J

TORBIDITY OF BIVERS AND ITS DISTRIBUTION IN THE CENTRAL CERROZEM FROVINCES, W70-09416

SELIBENTABY POLLUTION

BESTARCE MEEDS ON THERMAL AND SEDIMENTARY POLLUTION IN TIDAL

SECIMENTARY STRUCTURES
COMPUTATION OF THE DEPORBATICE OF BARS AND NAVIGATION

```
SEDIMENTATION
DEFOSITION OF FINE-GRAINED SUSPENDED SEDIMENT FROM TIDAL
  W70-09232
```

A SUMMARY OF PRELIMINARY STUDIES OF SEDIMENTATION AND HYDROLOGY IN BOLINAS LAGOON, MARIN COUNTY, CALIFORNIA, W70-09235

WATER BALANCE AND SILTING OF SHALL BESERVOIRS IN THE CENTRAL CHERNOZEM OF THE RUSSIAN SOVIET PEDERAL SOCIALIST BEPUBLIC: 1970-09312

WATER EROSION, THE FORMING OF SEDIMENT FLOW OF SHALL STREAM.
IN THE CENTRAL CHERNOZEM PROVINCES AND MEASURES FOF
PROTECTING RESERVOIRS FROM SILTING,

CHARACTERISTICS OF SILTING OF SHALL RESERVOIRS OF THE CENTRAL CHERNOZEH PROVINCES AND COMPUTATION OF DENSITY OF BOTTOM EEPOSITS, W70-05417 02J

DEVELOPING A METHOD OF COMPUTING SILTING OF SMALL FESEFVOIRS IN THE CENTRAL CHERNOZEM FROVINCES, 02J

SEDIMENTATION RATES
THE BALANCE METHOD OF COMPUTING SEDIMENT FLOW AND ESTIMATING
THE HATE OF SILTING OF RESERVOIRS,

CHARACTERISTICS OF SILTING OF SMALL BESERVOIRS OF THE CENTRAL CHERNOZEM PROVINCES AND COMPUTATION OF DENSITY OF BOTTCH LEFOSITS,

AGE OF QUATERNARY SEDIMENTS AND SOILS IN THE SACRAMENTO AREA, CALIFORNIA BY URANIUM AND ACTINIUM SERIES DATING OF VESTEERATE FOSSILS, W70-09239 02J

THE STAPILITY OF WHEAT EMBRYO GLUTAMATE DECARBOXYLASE UNDER CONDITIONS OF WATER STRESS, W70-09138

SEEDS FACTORS AFFECTING SEED GERMINATION UNDER SOIL MOISTURE

W70-09135 SEEPAGE
RESEARCH INTO THREE-DIMENSIONAL SEEPAGE IN JOINTED RCCK
FOUNDATIONS OF HIGH DAMS.
W70-09050
O4A

FINITE ELEMENT METHOD OF ANALYZING STEADY SEEFAGE WITH A FREE SUFFACE, W70-09198

SOME NUMERICAL METHODS FOR SOLVING PROBLEMS OF MON-STEADY SEEPAGE IN MON-HOMOGENEOUS ANISOTROFIC SOILS,

#70-09309 EFFECTS OF EFFLUENT AND INFLUENT SEEPAGE ON THE BYLRODINAMIC FORCES ACTING ON AN IDEALIZED MONCOHESIVE SEDIMENT PARTICLE, N70-09410 08B

SEEPAGE ICSSES
REDUCTION OF SEEPAGE LOSSES FROM IRRIGATION CANALS AS A RESULT OF SILTING, W70-09043

O3F

SEISHIC STUDIES
ACQUSTIC SUBBOTTOR PROFILING SYSTEMS, A STATE-OF-THE-ART

ESTIMATING STORAGE CAPACITY IN DEEP ALLUVIUM BY GRAVITI-SISMIC METHODS, . W70-09373

THE USE OF SEISHIC REPRACTION AND GRAVITY METHODS IN HYDROGEOLOGICAL INVESTIGATIONS, W70-09399 07B

A REVIEW OF SOME PROBLEMS OF SEISMIC PROSPECTING FCB GROUNDWATER IN SURFICIAL DEPOSITS, W70-09402 07B

SEISHIC METHODS IN MINING AND GROUNDWATER EXPLORATION, W70-09406 07B

SELF-PURIFICATION
SELF-PURIFICATION OF NATURAL WATERS FROM CARBCHYDFATES,
W70-Q910C 05B

OXIDATION OF ALCOHOLS AND THEIR INFLIENCE ON THE SEIF-PURIFICATION OF NATURAL WATERS, W70-09101 05B

SETTLEMENT (STRUCTURAL)

FOUNDATION SETTLEMENT AND GROUND REACTION CALCULATIONS USING
A DIGITAL COMPUTER,
W70-09036

08D

SETTLING PASINS
PAYNE V HISSOURI VALLEY DRAINAGE DIST NO 1 (CONSTRUCTION OF
NEW SETTLING BASIN AS REPAIR OF OLD EASIN).

SET-SOI

. 04p ¥70-09490

ETAGE SENAGE FLANT GRINDER PUMP, W70-09446

ESAGE BACTERIA
REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBIOSIS,
W70-C5187
050

PEAGE LISECSAL
THOMPSON W CITY OF PHILADELPHIA (DAMAGE CAUSED BY CITY
MAINTAINED SENAGE SYSTEM).
05G

WHACH EFFLUENTS
GIBSON V CITY OF TAMPA (POLLUTION OF OYSTER BEDS BY
UNIFIERTED MUNICIPAL SIWAGE).

THE SEASONAL FERFORMANCE AND THE PATTERNS OF CHEMICAL AND ELICIOGICAL EVENTS IN SEWAGE LAGOONS,

THERMAL EMERGY CONSERVATION AND SEQUENTIAL BIOLOGICAL PROCESSING APPLIED TO SEWAGE LAGOON DESIGN, 05D.

SEMAGE SYSTEMS

COMPREHENSIVE WATER SUPPLY; SEMERAGE, SOLID WASTE AND AIR FOLIUTION CONTROL PLANS, 06E

FREITHINABY WATER AND WASTE MANAGEMENT PLAN-670-09453 05D

EWAGE TREATMENT
ERITISH WATER FOLIDTION CONTROL,
W70-09041

REDUCING WASTE ACTIVATED SLUDGE VOLUME BY AMEROBIOSIS, W70-09187 05D

EFFFECT OF RECIRCULATION ON DEEP TRICKLING FILTER FEBFORMANCE, W70-09321 05D

CHARACTERISTICS OF WASTEWATER AT DELHI, 05D

SEMER DESIGN AN EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM DESIGN, W70-09185

SENER DESIGN FROBLEMS AN EVALUATION OF THE PROFILES OF SANITARY SENER SYSTEM IESIGN, W70-05125

ACKERHAM V TOWNSHIF OF NOFTH HUNTINGDON (MUNICIPAL AUTHORITY TO GEANT BIGHTS IN PRIVATELY CWNED SENER LINE). 870-09053

AN EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM IFSICN, W70-09185

EFFERING LAND CC V SPENCER (DRAINAGE DISTRICT HAS NO POWER TO CONSTRUCT SEVERS UNDER AUTHORITY FOR DRAIN CONSTRUCTION). W70-0948E

SHAFTS (EXCAVATION)
COMPLEX FEGIPHENT FOR SINKING AND DRILLING OF VERTICAL
SHAFTS,
870-09447

SECCH ICALS
CONTROL HECHANISHS OFFRATIVE IN A HATURAL HICROFIAL
FOFULATION SELECTED FOR ITS APILITY TO DEGRADE L-LYSINE,
III. FFFFCTS: CF CARECHITRATES IN CONTINUOUS-FLOW SYSTEMS
UNLEW SECCH LOAD CONDITIONS,
05D
05D

SHORES
ELISS V KINSEY (EXTENSION OF BOUNDARY LINES FROM MEANDER
IINE TO SHOPE LINE).
06E
070-09343

SILICA IQUIVALENCE OF AMONALOUS WATER AND SILICIC ACID SOLUTIONS, 670-09125

SILTING

BEDUCTION OF SEEPAGE LOSSES FROM IRRIGATION CANALS AS A

RESULT CF SILTING,

B70-09043

RATER BALANCE AND SILTIES OF SHALL RESERVOIRS IN THE CENTRAL CHERNOZEM OF THE RUSSIAN SOVIET FEDERAL SOCIALIST REPUBLIC. W70-05312

THE FALANCE METECO OF COMEUTING SEDIMENT PLOW AND ESTIMATING THE RATE OF SILTING OF RESERVCIES,

W70-09315

WATER EBOSION, THE FORMING OF SEDIMENT FLOW OF SMAIL STREAMS IN THE CENTRAL CHERNOZEM PROVINCES AND MEASURES FOR PROTECTING RESERVOIRS FROM SILTING,

CHARACTERISTICS OF SILTING OF SMALL RESERVOIRS OF THE CENTRAL CHERNOZEM PROVINCES AND COMPUTATION OF DENSITY OF BOTTCE LEFOSITS,

DEVELOFING A METHOD OF COMPUTING SILTING OF SHALL BESERVOIRS IN THE CENTRAL CHERNOZEM PROVINCES, W70-09418

SIMILARITY THEORY
TURBULENT DIFFUSION IN A STABLY STRATIFIED SHEAR LAYER,
W70-09173
08B

SIMULATION ANALYSIS
TURBULENT DIFFUSION IN A STABLY STRATIFIED SHEAR LAYER,
W70-09173
08B

AQUIFER SIMULATION ON SLOW TIME RESISTANCE-CAPACITANCE NETWORKS, W70-09226 02P

SIPHONS
TICAL PRENOMENA IN THE KARSTIC WATER LEVEL,
W70-09368
02F

ELECTRIC POWER - IMPACT ON THE ENVIRONMENT, W70-09020 06B

SLOFE FOSITION
EFFECT OF SOIL PROFILE TYPE AND FERTILIZER ON MOISTURE USE
BY WEEAT GROWN ON FALLOW OR STUBBLE LAND,
W70-09139 . 03F

EFFECT OF SOIL PROFILE TYPE AND FERTILIZER ON MOISTURE USE BY WREAT GROWN ON FALLOW OR STUEBLE LAND, W70-09139

SLUDGE DISPOSAL DIGESTED SLUDGE DISPOSAL ON CROP LAND, W70-09328

DEGRADATION OF WASTE WATER ORGANICS IN SOIL, W70-09329 05E

TREATMENT AND SLUDGE DISPOSAL OF WASTES FROM THE MANUFACTURE OF ACTIVATED CARBON, W70-09339 05D

SLUDGE TREATMENT REDUCING WASTE ACTIVATED SLUDGE VOLUME BY AMEROBICSIS, W70-09187

TREATMENT AND SLUDGE DISPOSAL OF WASTES FROM THE MANUFACTURE OF ACTIVATED CARBON,

SIUDGE WORKS
THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN
CONCENTRATION IN THE DELAWARE RIVER,
W70-09189
05C

SPILLWAY AND OUTLET WORKS, ROWLESBURG DAM, CHEAT FIVER, WEST WIRGINIA HYDRAULIC HODEL INVESTIGATION, 08B

SLUBBIES SEDIMENTATION
POLYMER PLUS HAGNETIC FIELD USED TO THEAT PARAMAGNETIC
SLUBBIES, R70-09318

COMPARATIVE STUDIES OF THE HOLLUSCICIDAL EFFECT OF CUFROUS CHIOGIFF AND COPPER SULFATE IN IRAN, W70-09432 SNAILS

PREPARATORY REPORT OF THE TECHNICAL SUBCOMMITTEE ON SHOW. W70-09351

EXPERIENCES WITH SNOW PILLOWS IN NORWAY, W70-09375

SHOWHELT RUNOFF SYNTHESIS FOR RAIN-ON-SHOW EASIN, W70-09027

SOIL CHEMICAL PROPERTIES
INFRARET SPECTROPHOTOMETRIC STUDY OF WET CLAY SOILS
(FRENCH), 470-09293

SOIL CHEHISTRY

EFFECTS OF SALTS AND ORGANIC MATERIALS ON THE HYDRAULIC COMBUCTIVITY OF THE SOILS,

02G

SOIL CLASSIFICATIONS
EVALUATION OF SOIL MOISTURE MEASUREMENTS IN OKLAHODA AS SOIL
CHARACTERISTICS FOR CLASSIFICATION,
02G

SC1-SCI

SCII CONSERVATION
SCIL, WATER AND SUBURBIA.
170-09188 06B SCII DIFFUSIVITY
ANALYSIS OF SOME FACTORS AFFECTING THE WATER VAPOUR DIFFUSION IN SCILS, W70-09295 SOIL DISPCSAL DEGRADATION OF WASTE WATER CRGANICS IN SOIL, 05E SCIL ENGINEERING SCIL, WATER AND SUBURBIA. W70-C9188 INFLUENCE OF RAINFALL ENERGY ON SOIL LOSS AND INFILTRATION FATES 2. IFFECT OF CICL SIZE DISTRIBUTION, 670-09378 SCIL MANAGEMENT
SCIL, WATER AND SUBURBIA.
W70-09188 06B THE BOVEHENT OF WATER IN SANDY SOILS AFTER PLOUGHING AT A FFFF OF 50 CENTIMETERS, W70-09303 02G SCII MCISTORE FACTORS AFFECTING SEED GERMINATION UNDER SOIL MOISTURE THE EFFECT OF SOIL MOISTURE LEVEL OF THE INCIDENCE OF EARLY ELIGHT ON POTATO AND ICHATO FLANTS, N70-09137 CN THE ADHESICN OF FORE WATER IN FINNISH ARGILLACEOUS SEDIMENTS OF DIFFERENT AGE, N70-09195 02G CCMPARATIVE STUDY OF THE WATER BALANCE IN THE AFRATED ZONES WITH RADIO-ACTIVITE HETHODS AND WEIGHABLE LYSIMETER, 670-05263 MEASURING SCII HOISTUGE IN THE PRENIG CATCHMENT PROOF USING NEUTRON SCATTER EQUIPMENT IN SOIL WITE PEATY IATES, #70-09264 02g PROBLEMS SOME METHODS FOR THE DETERMINATION OF SOIL MOISTURE AND 07B WATER TRANSFORT IN SOILS BY EVAPORATION AND INFILTRATION, W70-C9276 02D HYDROLOGICAL CONSTANTS OF PAMEEAN SCILS BROWN PRAIRIE AND ELACK PRAIRIE, N70-09287 THE RELATION BETWEEN LITHOLOGICAL FFORESTIES AND THE SHAPE OF THE DESCRIPTION CURVE, W70-05288 02G THE MICECHYLRCICGICAL CHARACTERIZATION OF SOILS, W70-09289 02G SCIL MOISTUFE FRESSURE IN SCHE CLIMATIC ZONES, 0.70-0.9291AN EMPIRICAL EXPRESSION FOR THE DESORPTION CURVE, 670-09292INFIDENCE OF SOIL STRUCTURE ON INFILTRATION AND PF VALUES OF CHERNOZEM ABD CEERNOZEMLIKE DARK HEADOW SOILS, 0.26 0.26EVALUATION CP SOIL MOISTURE MEASUREMENTS IN OKIAHOMA AS SOIL CEARACTERISTICS FOR CLASSIFICATION, NOO-09377 SOIL HCISTURE BETERS
AN INSTRUBERT PCE MEASURING SCIL MOISTURE BY NEUTRON CHANGES IN THE MOISTURE CONTENT OF THE TOPSOIL AS MEASURED WITH A REUTION MOISTURE GAUGE, W70-0926 THE DETERMINATION OF SCIL MOISTURE WITH THE NEUTRON SCATTERING MFTHOD IN FINLAND, W70-09267 07B NEUTION MOISTURE METER FOR SALINE SCILS, N70-09268 FCLISH ISOTOPE APPARATUS FOR RESEARCH ON SOIL MOISTURE, $670\!-\!69271$ NUCLEAR TECHNIQUES IN HYDROLOGICAL INVESTIGATIONS IN THE INSATURATED ZONE, 870-09272 07P

CALIERATION AND EVALUATION OF A WIDE RANGE METHOD FOR

MEASURING MOISTURE STRESS IN FIELD SOIL SAMPLES, 870-05273 HYDRAULIC AND PRESSURE HEAD MEASUREMENT WITH STRAIN GAUGE F PRESSURE THANSDUCERS, W70-09274 DIRECT MEASUREMENT OF MOISTURE POTENTIAL A NEW TECHNIQUES W70-09275 EVALUATION OF SOIL HOISTURE MEASUREMENTS IN OFLINENT AS SCIENCE OF CLASSIFICATION, N70-09377 02G A GAMMA-EHOTONEUTRON METHOD FOR LABORATORY STUDIES OF SOIL WATEF, W70-05382 MEASUREMENT OF WATER POTENTIAL AND OSMOTIC POTENTIALS IN SOIL WITH A COMBINED THERMOCOUPLE PSYCHROBETER AND SALINITY WITH-69384 SOIL MOISTURE MOVEMENT
DIFFUSIVITY DETERMINATION BY A NEW OUTFLOW METHOD, W70-09278
07B SOIL MCISTURE PEDISTRIBUTION
A STUDY OF REDISTRIBUTION AFTER THE FINISH OF HORIZONTAL INFILTRATION (PRENCH), #70-09304

O2G SOIL MCISTURE REGIME
HYDROPHYSICAL PROPERTIES AND MCISTURE REGIME IN THE
UNSATURATED ZONE, ¥70-09261 SOIL OFGANIC MATTER
A KINETIC AND EQUILIBRIUM STUDY OF THE ADSCRPTION OF THE ORGANIC INSECTICIDES CARBARYL AND PARATHION UPON SCHE SOIL OFGANIC MATTER SURFACES,
W70-09184
05a SOIL PHYSICAL FROPERTIES
THE RELATION BETWEEN LITHOLOGICAL PROFERTIES AND THE SHAPE
OF THE LESCRIPTION CURVE,
W70-09288
02G INFILTRATION PROPERTIES OF THE SOILS OF THE CENTRAL CHERNOZER PROVINCES, W70-09313 02G AN AFFROXIMATE METHOD FOR DETERMINING THE HYDRAULIC COMPOCITIVITY FUNCTION OF UNSATURATED SOIL, W7C-09342 SOIL EFFSSURE FOUNDATION SETTLEMENT AND GROUND REACTION CALCULATIONS USINA ELICITAL COMPUTER, W70-09036 SOIL PROPERTIES
HYDROLOGICAL CONSTANTS OF PAMPEAN SOILS FROWN PHAIRIF AND
ELACK FRAIRIE,
W70-05287
02G THE MICROHYDROLOGICAL CHARACTERIZATION OF SOIIS, INFILTRATION RATE AS RELATED TO HYDRAULIC CONFUCTIVITY, MOISTUBE DEFICIT AND OTHER SOIL PROPERTIES, #70-0300 02g INFILTRATION PROPERTIES OF THE SOILS OF THE CENTRAL CHERNIZEM PROVINCES, W70-09313 02G SOIL STAPILIZATION
SOIL, WATER AND SUBURBIA.
W70-09188 SOIL STRENGTH RHEOLOGICAL AND ULTIMATE STRENGTH PROFERTIES OF COFESIVE SCILS, k70-09452 SOIL STRUCTURE
INFRARET SPECTROPHOTOMETRIC STUDY OF WET CLAY SOILS INFLUENCE OF SOIL STRUCTURE ON INFILITATION AND PF VALUES OF CHERNOZEM AND CHERNOZEMLIKE DARK HEADOW SOILS, W70-09294 THE HOVEMENT OF WATER IN SANDY SOILS AFTER PLOUGHING AT A DEFTH OF 50 CENTIMETERS, #70-09303 02G SOIL TESTS
RHEOLOGICAL AND ULTIMATE STRENGTH PROPERTIES OF CCHESIVE SOILS, W70-09452 SOIL WATER
ON THE ADHESION OF PORE WATER IN FINNISH ARGILLACPOUS
SEDIMENTS OF DIFFERENT AGE,
W70-09195 HYDROPHYSICAL PROPERTIES AND MOISTURE REGIME IN THE UNSATURATED ZONE,

02G

INFILIRATION PROPERTIES OF THE SOILS OF THE CENTRAL

SOIL TEMFERATURE AND WATER CONTENT CHANGES DURING DEVING AS INFLUENCED BY CRACKS A LABORATORY EXPERIMENT, W7C-09379 02G

CIL WATER MOVEMENT NUMBERCAL MCDELING OF UNSATURATED GROUNDWATER FICW AND COMPARISON OF THE MODEL TO A FIELD EXPERIMENT, W70-09107

FOST-IRRIGATION MOVEMENT OF SOIL WATER 1. REDISTRIBUTION, \$70-05124

MIGRATICN OF SOLUBLE SALTS IN AN IRRIGATED PIELD IN RELATION TO RAINFAIL AND IRRIGATION, N70-09140 03C

THE TERFESTRIAL FCCICGY OF THE SPACEFOOT TOAD SCAPHIOPUS EAMHCHDIL, N70-09146 02G

A MCVING BOUNDARY MODEL OF A CNE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIENT POROUS FLOW SYSTEM,

THE THREE-PEASE COMAIN IN HYDROLOGY, N70-09260

EYEROPHYSICAL FROPERTIES AND MOISTURE REGIME IN THE UNSATURATED ZONE, W70-09261 02G

HYDRAULIC AND ERESSORE HEAD MEASUREMENT WITH STRAIN GAUGE ERESSURE TRANSDUCERS, W70-09274 07E

WATER TEANSFORT IN SCILS BY EVAFORATION AND INFILTRATION, 670-09276 02D

SOIL WATER EIPFUSIVITY AND WATER CONTENT DISTRIBUTION DURING CUTFLOW EXPERIFERT, 02G

PN INFILIRATION METHOD FOR THE DETERMINATION OF THE CAPILLARY CONDUCTIVITY OF UNDISTURBED SOIL CORES, W70-C9261 07E

CETERHINATION OF THE COEFFICIENTS OF WATER MIGRATION THROUGH SCIIS, \$70-09283

CIVERGENCES BETWEEN EXPERIMENTAL AND THEORETICAL VALUES OF CAPILLABY DIFFUSIVITY (FRENCH), 02G

VERIFICATION OF THE GENERALIZED DARCY'S LAW AND DETERMINATION OF CAPILLARY CONDUCTIVITY AT THE BEGINNING OF ECELZONAL INFILITEATION (FRENCH),

ANALYSIS OF SOME PACTORS AFFECTING THE WATER VAPOUR INFRUSION IN SCILS, 02G

MCISTORE CONTENT AND RYDROPHILITY AS RELATED TO THE WATER CAPILLARY RISE IN SCILS, 02G

REDISTRIBUTION OF MOISTUFE AFTER INFILTRATION IN DRY SOILS.
INFLUENCE OF GRAVITY,
N70-09269
026

INFILTRATION IN TERMS OF SOIL MOISTURE, RAIN INTENSITY AND LEFTE OF BAINFAIL, 02G

A STUDY OF REDISTRIBUTION AFTER THE FINISH OF HOSTZONTAL INFILTRATION (FRENCH),

A THEORYTICAL ANALYSIS AND NUMERICAL SOLUTIONS OF UNSATURATED FLOW IN SOIL, 02G

ANALYSIS OF INFILTRATION INTO STRATIFIED SOIL COLUMNS, W70-09306 02G

A LINEAFIZATION TECHNIQUE FOR THE STUDY OF INFILTRATION, W70-09307

SCLUTIONS OF THE NON-LINEAR DIFFUSION EQUATION WITE A GRAVITY TERM IN HYDEOLOGY, 02G

SCHE NOBERICAL MITHODS FOR SOLVING PROBLEMS OF HON-STEADY SEEPAGE IN NON-ROBOGENEOUS ANISOTROFIC SOILS, W70-09309 02G

RESCRETION AND INFILTRATION IN TWO- AND THREE-DIREKSIONAL EXSIEMS, 1670-09310

THE EFFECT OF TEMPERATURE ON WATER PLOR IN SOILS, 170-09345

FREEZING AND THAWING EFFECTS ON DRAINAGE,

W7-0-09380

SOIL WATER RETENTION
THE NATURE OF THE MINIMAL WATER RETENTIVE CAPACITY,
0.2G

SOILS
AGE OF QUATERNARY SEDIMENTS AND SOILS IN THE SACRAMENTO
AREA, CALIFORNIA BY URANIUM AND ACTINIUM SERIES DATING OF
VEFTEREPTF FOSSILS,

02J

DEGRADATION OF WASTE WATER ORGANICS IN SOIL,

SOIL-WATER-PLANT RELATIONSHIPS
PIANT CCVER, RUNOFF, AND SEDIMENT YIELD RELATIONSHIPS ON
MANCOS SHALE IN WESTERN CCIORADO,

SOIL, WATER AND SUBURBIA. W70-09188

THE ROLE OF VEGETATION IN SOIL WATER FROBLEMS, W70-09262 02I

A PREDICTION EQUATION FOR VEGETATION EPPECTS ON WATER YIELD PROM WATERSHEDS IN ARID AREAS,

SOLAR DISTILLATION
MANUAL ON SOLAR DISTILLATION OF SALINE WATER,
03A W70-09244

SCLAR RADIATION A DIURNAL DISTRIBUTION PUNCTION FOR DAILY EVAPORATION, W70-09205

MANUAL ON SOLAR DISTILLATION OF SALINE WATER, W70-09244

SOLID WASTES
FLY ASB UTILIZATION CLIMBING STEADILY.
W70-09040 08G

SOLID-STATE VALVES
THE NEW BRUNSWICK ELECTRIC POWER COMMISSION SCLID STATESTATE HVDC ASYNCHRONOUS TIE INSTALLATION,
08C

SOLUBLE SALTS
MIGRATION OF SOLUBLE SALTS IN AN IRRIGATED FIELD IN RELATION
TO RAINFAIL AND IRRIGATION,
03C

SOLUTION CHANNELS
RESERVOIR LEAKAGE IN LIMESTONE TERRAINS,
04A

UNDING
ISOPACHOUS MAPPING OF THE LOWER PATUXENT ESTUARY SEDIMENTS
BY CONTINUOUS SEISMIC PROFILING TECHNIQUES,

SOUTH CAROLINA
GROUNDWATER RECORDS OF SOUTH CAROLINA - 1966,
W70-09411

SPACE HEATING IN URBAN ENVIRONMENTS,

USES OF WASTE HEAT, W70-09193

SEAWBING SUCCESS

EFFECTS OF DIQUAT ON BLUEGILLS AND THEIR FOOD ORGANISMS, W70-09431

SPILLWAY AND OUTLRY WORKS, ROWLESBURG DAM, CHEAT RIVER, WEST VIRGINIA HYDRAULIC MODEL INVESTIGATION, W70-09180

SPRINGS
TIDAL PHENOMENA IN THE KARSTIC WATER LEVEL,
W70-09368

SSARE (ACRONYM)
RUNOFF SYNTHESIS FOR RAIN-ON-SNOW BASIN,
W70-09027

STAGE-DISCHARGE RELATIONS
CALLERATION OF WALNUT GULCH SUPERCRITICAL FLUMES,
W70-09218
02E

A NOTE OF THE ESTIMATION OF THE PARAMETERS IN LOGARITHMIC STAGE-DISCHARGE RELATIONSHIPS WITH ESTIMATES OF THEIR ERROR, W70-09374

STATISTICAL METHODS
USE OF TOPOLOGIC INFORMATION IN PROCESSING DATA FOR CHANNEL NETWORKS.

07C

A NOTE ON THE ESTIMATION OF THE PARAMETERS IN LOGARITHMIC STAGE-LISCHARGE RELATIONSHIPS WITH ESTIMATES OF THEIR ERROR, W70-09374

HYDROLOGICAL SERIES AS A BASIS FOR WATER RESOURCES FOLICY,

STA-SUR 061 W70-09387 APPLICATION OF REGRESSION ANALYSIS IN HYDROLOGY, N70-09391 STATISTICAL HCDEIS STOCHASTIC MODELS IN HYDROLOGY, W70-09115 064 A TWC-SIEP EROBAEILISTIC HODEL OF STORAGE RESERVOIR WITH CORRELATED IMPUIS, 870-09716 06A ATISTICS
CHARACTERISTICS OF WASTEWATER AT DELHI,
05D STEAM TUREINES
SPACE HEATING IN URBAN ENVIRONMENTS,
W70-09192 USES OF WASTE BEAT, E70-09193 03C SICCHASIIC HOLEIS
TRACER SIDDIES ON THE HOVEMENT OF SAND AND GRAVEL,
\$70-09024
02J SICCHASTIC FRCCESSES A MODEL OF WATER QUALITY HANAGEMENT UNDER UNCERTAINTY, 870-09109 STCCHASTIC MODELS IN HYDROLOGY, 570-09115 STCFAGE COFFFICIENT

CN THE SOLUTION OF INVERSE PROBLEMS IN HYDROGEOLOGY
(FFEBCE),
W70-09371

02P STCHAGE TABRS
THE OPTIBIZATION OF STCRM-HOLDING TANKS A PROBLEM OF WATER FOLIUTION CONTROL, W70-09161

05G STORM CRAINS
THE OPTIMIZATION OF STORM-HOLDING TANKS A PROBLEM OF WATER FOLIUTION CONTROL, W70-09161 05G SICEM BUNCEF FERENS OF FOREST CLEAR-FELLING ON THE STORM HYDROGRAPH, #70-09117 03B STORM SENAGE
THE OPTIMIZATION OF STORM-HOLDING TANKS A PROBLEM OF WATER
FOLIUTION CONTROL,
870-09181
056 STRATIFICATION ANALYSIS OF INFILTRATION INTO STRATIFIED SOIL COLUMNS, W70-09306 026 STRATIFIET SOIIS
ABALYSIS OF INFILTRATION INTO STRATIFIED SOII COLUMNS, W70-09306 02G SIBEAH FICH SELF-PURIFICATION OF NATURAL WATERS FROM CARBOHYDRATES, W70 \sim 09100 05 B FLOOD SERIES FOR GAGED PENNSYLVANIA STREAMS, W70-09420 02E STREAM GACES
CALIBRATICN OF WALBUT GUICH SUPERCRITICAL FLUMES,
W70-09218
022 FICCE SERIES FOR GAGED PENNSYLVANIA STREAMS, W70-C9420 02E STREAMERCS
ACOUSTIC SUBBOTTCH PROFILING SYSTEMS, A STATE-OF-THE-ART SDEVEY, 870-09176 CABTER CII CO V DELUCETH (LESSEE OF LAND ABOTTING CREEK HAS FIGHT TO CREEK PED). STREAMFICH
THE EFFECT OF BED-LOAD HOVEMENT ON THE VELOCITY DISTRIBUTION
OF FICH,
PTC-09052
02J CXICATION OF ALCOHOLS AND THEIR INFLUENCE ON THE SELF-FURIFICATION OF NATURAL WATERS, W70-C9101 05E DISSOLVED SCLIDS-DISCHARGE RELATIONSHIPS 1. MIXING A FEOPOSED STREAMFLOW DATA PROGRAM FOR MAINE, 970-09353

TUBELDING OF RIVERS AND ITS DISTRIBUTION IN THE CENTRAL CHERNOZED FROVINCES, 870-09416 02J

STREAMFICH POFECASTING

A MODEL OF WATER QUALITY MANAGEMENT UNDER UNCERTAINTY, 870-09109 STRESS-STRAIN CURVES A REVIEW OF STRESS-STRAIN RELATIONSHIPS FOR CONCRET*, #70-09032 STRONTIUM PACIOISOTOPES PRONTION PADIOISOTOPES
SIRONTION 90 CONCENTRATIONS IN SURFACE AIR
YERSUS ATLANTIC OCEAN PROM 1966 TO 1969,
970-06229
022 STUBBLE BUICHING EFFECT OF SOIL PROFILE TYPE AND FERTILIZER ON MOISTORE USE: BY WHEAT GROWN ON PALLOW OR STUBBLE LAND, W70-05139 SUBMARINE CABLES
CATHODIC PROTECTION OF THE BONNEVILLE POWER ADBINISTRATION 134.5 KV SAN JUAN ISLANDS CABLE,
08C SUPERVISION, CONSTRUCTION AND EVALUATION OF A SEA WATER DESUIFATING PROCESS PILOT PLANT, W70-09354 O3A SULFUR ELEMENTAL SULFUR IN EDDY COUNTY, NEW MEXICO, SUNDANGRASS FORACE CROP IRRIGATION WITH OXIDATION POND EFFLUENT, W70-05423 05D EFFECTS OF DIQUAT ON BLUEGILLS AND THEIR FOOD ORGANISMS, N70-09431 TOXICITY OF SELECTED HERBICIDES TO BICEGILL SUNFISH, W70-09435 SUPERCRITICAL FLOW CALTEBATION OF WALNUT GULCH SUPERCRITICAL FLUMES, W70-09218 02E SUPPLY CONTRACTS
PUERIO RICO V RUSSELL AND CO (IMPOSED TAX AS IMPAIFMENT OF CONTRACT FOR WATER SUPPLY).
W70-09072
06E SURFACE RUNOPP

BD OF EFUC. W MORTH HEMPSTEAD (NO RIGHT TO DAMAGES FOR MATURAL PLOW OF SURFACE WATERS).

W70-09055. SURFACE-GROUNDWATER RELATIONSHIPS
NUMERICAL MODELING OF UNSATURATED GROUNDWATER FLOW AND
COMPARISON OF THE MODEL TO A FIELD EXFERIMENT,
W70-09107
02P ELECTROLYTIC MODEL STUDY FOR COLLECTOR WELLS UNDER RIVER EECS, #70-09210 COMMON EBRORS IN DEVELOPING A GROUNDWATER ACUIPER, W70-09225 SURFACTANTS
INPROVENENT OF TUBULAR CELLULOSE ACETATE HEMBRANES ET FEED
ACETITYES,
W70-09246
03A AMIONIC AND NOWIONIC SURFACTANT SOBPTION AND DEGRALATION BY ALCAF CULTURES, W70-09438 05C SURVEYS
HONTELY HEAW SURFACE TEMPERATURES FOR LAKE ONTARIO AS
DETERMINED BY ABRIAL SURVEY,
W70-09206
02H COASTAL WETLANDS OF VIRGINIA-INTERIS REPORT, W70-09350 021 A GEOCHEMICAL DRAINAGE SURVEY IN CENTRAL ECUADOR, W70-09352 GBOPHYSICS IN PROSPECTING AND EXPLORATION FOR MINEFAL LIPOSITS IN THE U.S.S.R., with the u.S.S.R., 07B $$\rm 0.7B$ APPLIED GEOPHYSICS IN THE NATURAL ENVIRONMENT RESEASCH COUNCIL IN GREAT BRITAIN, W70-09399 078 GEOPHYSICAL PROSPECTING FOR GROUNDWATER IN THE SOVIET UNION, W70-09401 A REVIEW OF SOME PROBLEMS OF SEISHIC PROSPECTING FCB GROUNDWAIRS IN SUBFICIAL DEPOSITS.

W70-09402 07B INTEGRATION OF GEOPHISICAL METHODS FOR GROUNDWATER EXELERATION IN THE PRAIRIE PROTUNCES, CAMADA, W70-09403 INTEGRATION OF GEOPHYSICS AND HYDROGECLOGY IN THE SCIUTICS OF REGIONAL GROUNDWATER PROBLEMS, 07B

FUECT TABLEY SUR-THI

HE BOLE OF GEOPHYSICS IN THE DEVELOPMENT OF THE WORLD'S BOUNCHMATER RESOURCES, 70-094C5 07B FISHIC METEODS IN MINING AND GROUNDWATER EXPLORATION, 70-09406 PETICATION OF SESSETIVITY METRODS IN MINEBAL AND REGULERATER EXPLORATION PROGRAMS, 0.7B HE USE OF GRAVIMETER MEASUREMENTS IN MINING AND GROUNDWATER RELIGIOUS.
170-09408 076 INTERPRETATION OF GECELECTRICAL RESISTIVITY MEASUREMENTS FOR CLUVING HYDROGEOLOGICAL FROBLEMS, 07B SEENCED ICAL FLUME STUDIES OF THE SEDIMENT TEAMSFEE COEFFICIENT, 670-09119 02J VISUAL CESSEVATIONS OF SUSPENDED-PARTICLE DISTRIBUTION AT THREE SITES IN THE CARIFFEAN SEA, W70-09231 02J SPENCED SEDIMENTS AN ELECTRO-OPTICAL PROPE FOR MEASUREMENT OF SUSPENDED SECUMENT CORCENTRATION, NTO-09026 02J SPENDED SCLIDS
TREATHERT AND SLUDGE DISEOSAL OF WASTES FROM THE MANUFACTURE
OF ACTIVATE CARECY,
#70~0935 SEENSION FIUME STODIES OF THE SEDIMENT TRANSFER COEFFICIENT, W70-09119 02J INFUISE DISCHARGE CK CONTAMINATED SURFACE, #70-09039 08C ITCHING
SWITCHING-SURGE CONSIDERATIONS IN UHV TRANSMISSION LINE
LESIGN,
W70-0921 TICEING SURGES
SWITCHING-SURGE CONSIDERATIONS IN UNV TRANSMISSION LINE
IESIGN,
W70-09021
08C VECPTIC ANALYSIS
WATER VAFOR BALANCE OF THE ATMOSPHERE FROM FIVE YEARS OF
HEMISPHERIC DATA.

(28) YKTHESIS RUNCFF SYNTHESIS FOR FAIN-ON-SHOW EASIN N7C-09027 YETHETIC HYDFOLOGY BUNCFF SYMTHESIS PCF BAIB-OB-SHOW FASIN, M70-09027 02E YSTEMS ANALYSIS
APPLICATION OF SPECIALIZED CPTIMIZATION TECHNIQUES FOR WATER
COLLITY AND QUANTITY MANAGEMENT WITH RESPECT TO FLANKING FOR
THE TRIKITY BIVEF BASIN,
W70-C9054 A METHOD POS THE EVALUATION OF THE SISTEM AND COST REFERCTIVENESS OF LARGE SEA WATER DISTILLATION PLANTS, \$70-09247 FOR BASS BALANCE AND WATER QUALITY STANDARDS, 05A ON THE SYSTEMS AFPROACH IN HYDROLOGY, 02A A SYSTEM APERCACH FOR THE STUDY AND CONTROL OF PACTORS AFFECTING WATER FOLIUTICM, U70-09422 AILWATER
ENVIRONMENTAL CHANGES PRODUCED BY COLD-WATER OUTLETS PROM
TERFE ABRANSAS DESERVOIRS,
670-09344
06G AMARISK WATER USE BY SALT CEDAR, W70-09113 CATTLE SKIN TANNERY WASTES TREATHENT IN A COMPLETELY HIXED ACTIVATED SIDGE FILCT PLANT, 05D W70-09324

AVES V DEAVO CONTRACTING CC (STATE'S RIGHT TO TAX FEDERAL GOVERNMENT'S CONTRACTORS).

FUEBTO SICO V RUSSELL AND CO (IMPOSED TAX AS IMPAIRMENT OF CONTRACT FOR WATER SUFFLY).

#70-09072

C6E

TECHNOLOGY WATER TECHNOLOGY, W70-09361 1969 HVDC STRAY CURRENT TESTS ON UNDERGROUND TELEFECHE TEMPERATURE—DEPENDENT CHARACTERISTICS OF PERIFHERAL MERVES EXPOSED TO DIFFERENT THERMAL CONDITIONS IN THE SAME ANIMAL, W70-09160 EFFECT OF TEMPERATURE AND SALINITY ON THE HEAT TOLEBANCE IN THE BERMIT CRAB, DIOGENES BICRISTIMANUS, W70-09166 05C ENVIRONMENTAL CHANGES PRODUCED BY COLD-WATER OUTLETS FROM THREE ARKANSAS RESERVOIRS, W70-09344 06G THE EFFECT OF TEMPERATURE ON WATER FICE IN SOILS, $\ensuremath{\text{W}}70-09345$ TEMPERATURE CONTROL
CONTROL AND REPAIR OF CRACKS IN CONCRETE DAMS,
W70-09019
08F TEMPERATURE EFFECTS

EFFECT OF TEMPERATURE SHOCK ON THE TEMPERATURE RESISTANCE OF POIXTLOTHERM AQUATIC ANIMALS. EXPERIMENTS ON THE FROBLEM OF HEAT AND COLD-HARDENING IN ANIMALS (GERHAM), W70-05436 TEMPERATURE SELECTION OF SHALL HYPOPHYSECTOBIZED GOLDRISE, (CARASSIUS AURATUS L.), U70-09151 05c TENNESSEE VALLEY AUTHORITY PROJECT UNITED STATES EX REL TVA V POWELSON (CONDENNATION VALUATION). W70-09459 06E DIRECT HEASUREMENT OF MOISTURE FOTENTIAL A NEW TECHNIQUE, 970-09275 TERHINAL FACILITIES (ELECT)
PREDICTION OF RELIABILITY AND AVAILABILITY OF HVDC VALVE AND
HVDC TERHINAL,
W70-09017
08C TERTIABY TREATHENT
EPPECITVE PHOSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE
ACTIVATED SLUDGE PROCESS,
870-09186
05D A STATEMENT ON PHOSPHORUS, W70-09325 AERATED LAGOONS TREAT SECONDARY EFFLUENT, W70-09331 05D TEST PROCEDURES
AN ANALYTICAL METHOD FOR EVALUATING THE SUSCEPTIBILITY OF
PISH SPICIES TO AN AGRICULTURAL CHEMICAL (JAPANESE),
W70-09433 TESTING ENERGY AND HYDRAULIC TESTS ON MECHANICAL ABRATION SYSTEMS, $\ensuremath{\text{W70-09503}}$ FREEZING AND THAWING EFFECTS ON DEAINAGE, W70-09380 02G THEIS EQUATION
PUMPING TESTS AND HYDROGEOLOGICAL INVESTIGATIONS OF AN
ARTESIAN AQUIFER NEAR HORSENS, DENHARK,
W70-09237 THERBAL CONDUCTIVITY
HEASUREMENT OF THE THERBAL CONDUCTIVITY OF FROST BY A
TRANSIENT HOT-WIRE TECHNIQUE,
W70-09233
02C MEASUREMENT OF SOIL MOISTURE FROM THE TEMPERATURE GRADIENT, W70-09269 THERMAL ENERGY CONSERVATION AND SEQUENTIAL BIOLOGICAL PROCESSING APPLIED TO SEWAGE LAGOON DESIGN, 05D w70-09334 THERHAL ECLLUTION
RESEARCH NEEDS ON THERHAL AND SEDIMENTARY POLLUTION IN TIDAL EFFECTS OF THERMAL DISCHARGE FROM THE SAN ONOFRE NUCLEAR GENEBATING STATION, 050 TEMPERATURE, REPRODUCTION AND BEHAVIOR, 05C

TOXIC WASTES

SPACE HEATING IN URBAN ENVIRONMENTS, W70-09192	08C	P.F
TSES OF WASTE HEAT, W70-09193	03C	ET WA
ECLIUTION OF ESTUARIES, W70-09383	05C	TW.
THERMAL ECHER SPACE HEATING IN URBAN ENVIRONMENTS,		AS W7
W70-09192	08C	PI OI
TSES OF WASTE REAT, W70-09193	J3C	PI
THERMAL ECWEFFLANTS SPACE HEATING IN URBAN ENVIRONMENTS, #70-09152	08C	TO W7
USES OF WASTE HEAT, W70-09193	03C	rrac M1
THEFMAI STRINGS EYDROCARBONS IN THEFMAL AREAS, NORTHWE	STERN WYOMING,	01 #7
	02K	A W7
IURBULENT DIFFUSION IN A STAELY STRATI	TEFIED SHEAR LAYER, TOORS	TE W7
TREEMAL STRESS EFFICE OF TEMPERATURE SHOCK ON THE TEM ECIKILCHEEF ACOATIC ANIMALS, EXFERIM EAT ANI COLD-BARDENING IN ANIMALS (GE W70-09436	IENTS ON THE PROBLEM OF	V S
THERMOCLINE NOTES ON A THEORY OF THE THERMOCLINE,		W7
N7C-C9191 THERNCHETERS	05E	PI W7
E-N JUNCTIONSA TOOL PCR TEMPERATURE W70-09212	MEASUREMENT, T	RAC VA
THICKENING TEICKENING CHARACTERISTICS OF ACTIVATE W70-09505	ED SLUDGE, 05D	DE FI
THREE CIMENSICNAL ANALYSIS TURBULENT DIFFUSION IN A STABLY STRATE W70-09173	FIED SHEAR LAYEF, TOORE	TE
THYFISTORS THE NEW FRUNSWICK ELECTRIC POWER COMMISTALLATION OF THE STATE BYDO ASYNCHRONGUS TIF INSTALLATION OF THE STATE O		SW DE
TITAL EFFECTS CEPOSITION CF FINE-GRAINED SUSPENDED S	SEDIMENT PROM TIDAL	W7
CUFFENTS, W70-09232	021	TI W7
TICAL WATERS FESTABCE NEEDS ON THERMAL AND SEDIMENT WATERS. W70-09161		PAN PE HV W7
TEPCSITION OF FINE-GRAINED SUSPENDED S CURRENTS.	EDIMENT FROM TIDAL T	RA1
#70-09232 Tites	021	(E
TIDAL PHENOMENA IN THE KARSTIC WATER I #70-09368	EVEL, 02F	RAT TF
	TION OF PRECIPITATION,	W7 CPFI KI
TIPE SERIES ANALYSIS EYDROLOGICAL SERIES AS A BASIS FOR WAT W70-05387		W7
TISSUE DE SICCATION PHYSIOLOGICAL RESPONSES TO TEMPERATURE	AND DESICCATION IN	CF W7
THE ENDINC NEW MEXICO PLETHOCONTIDS, AND ANELES HARDII,	PLETHODON NEONEXICANUS T	TRIC
TCALS		PI W7
THE TERRESTRIAL ECOLOGY OF THE SPADERO BAHHONDII, W70-09146	O2G TOAD SCAPHIOPUS	rrin A A!
HEART RATE AND CHANGES IN BODY FLUIDS FROM XEGIC BABITATS,		W.
W70-09148	021	HI
THE EFFECT OF SOIL MOISTURE LEVEL OF TELIGHT OF POTATO AND TOMATO PLANTS.	O2I	PORT EI
TOURISM THE IMPORTANCE OF WATER RELATED ACTIVE MISSISSIPPE,	ITIES AT STATE PARKS IN	W: IUNI

```
THE ORIGIN AND CHARACTERISTICS OF TOXIC WASTES, WITH PARTICULAR REPERENCE TO THE HETAL INDUSTRIES, W70-09340 05D
   PECT OF TOXIC WASTES ON TREATMENT PROCESSES AND TREACCURSES, 0-09341
   SLIMINARY RESULTS OF THE EXPERIMENTS ON THE TOXICITY OF A L COUNTERACTING AGENT (ESSO COREXIT 7664), WITH AND THOUT IRAQ CRUDE OIL, FOR SELECTED HEMBERS OF MARINE
   ANKTON,
0-09434
   EXECUTY OF SELECTED HERBICIDES TO BLUEGILL SUNFISH, 10-09435
   E ELZMENTS
CROCKLIMENTS IN ATMOSPHERIC PRECIPITATION IN THE
KAZNENSKIY RESERVOIR AREA,
0-09099
02B
   GEOCHEMICAL DRAINAGE SURVEY IN CENTRAL ECUADOR, 0-09352
   ERS .
AACER STUDIES ON THE MOVEMENT OF SAND AND GRAVEL,
0-09024 02J
   E CF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING, 0-09029 G7R
   LILITY CONDITIONS OF THE POINT DISUTION METHOD, 0-09284
   TERBINATION OF THE VELOCITY AND DIRECTION OF GROUNDWATER OF REPORT OF THE CONTROL OF T
   KING TECHNIQUES
LIDITY CONDITIONS OF THE POINT DIJUTION METHOD,
0-05264 029
   TERMINATION OF THE VELOCITY AND DIRECTION OF GROUNDWATER ON BY RADIOISOTOPES, 0-09366 02F
   SHISSION LINES
ANSIENT OVERVOLTAGE OF A BIPOLAR BYCC OVERHEAD LINE CAUSE
DC LINE FAULTS,
   ITCHING-SURGE CONSIDERATIONS IN UNV TRANSMISSION LINE
   SIGN,
0-09021
   LCULATION OF RADIO NOISE LEVEL FOR THE DESIGN OF AC POWER ANSMISSION LINES, 0-05038
   SKISSION (ELECTRICAL)
EDICATION OF RELIABILITY AND AVAILABILITY OF HVDC VALVE AND CC TEPHINAL,
0-09017 OBC
   SHISSIVITY
THE SOLUTION OF INVERSE PROBLEMS IN HYDROGEOLOGY
FEENCH),
0-09371 02F
   SPIRATION CONTROL
ANSPIRATION OF PONDERCSA PINE AND DOUGLAS FIR AFIFE
FRAMMENT WITH PHENYLMERCURIC ACETATE,
0-09207
03B
   THENT
NETIC ASPECTS OF THE TREATMENT OF PHENOLIC WASTES,
0-09506 05D
   THENT FACILITY

ARACTERISTICS OF WASTEWATER AT DELHY,
0-09327

050
   KLING FILTERS
FECT OF RECIRCULATION ON DEEP TRICKLING FILTER
FFCRBANCE,
   TION
MODIFICATION OF THE BENZENE SYNTHESIS METHOD FOR TRITION
NALYSIS,
00-09213
   PICAL REGIONS
BAT WASTE,
70-09162
   TYTRONMENTAL CEANGES PRODUCED BY COLD-WATER CUTLETS FROM
TREE ARKANSAS RESERVOTES,
0-09344 06G
     RACTERISTICS OF PERNAPROST AND OF THE ACTIVE LAYER IN
WEST SIBERIA,
W70-09257
```

SUBJECT INDEX

NEL HYDRAULICS EOUT THE ROUGHNESS PROBLEM IN PIPES AND TUNNELS, 176-09011 08b NEIS
BOUT THE ROUGHNESS FROBLEM IN PIPES AND TUNNELS, 170-09011 088 ROSSING THE SIEBRA MADRE FAUIT ZONE IM THE GLENDOBA TUNNEL, FAN CADFIEL MOUNTAINS, CALIFORNIA, 70-09031 08E TUREULENT EIFFUSICN IN A STAELY STRATIFIED SHEAR LAYER, W70~09173 FEICITY
TURBIDITY OF RIVERS AND ITS DISTRIBUTION IN THE CENTRAL
CREENCZEM FFOVINCES,
W70-09416 02J EUNYANT FLUMES AND THERMALS, W70-C9168 TORROLLENCE MEASUREMENTS NEAR THE FREE SURFACE OF AN OPEN CHANNEL FICE.

070-09208
02E EGICITY
THE EFFECT OF SOIL MOISTURE LEVEL OF THE INCIDENCE OF EARLY
PLIGHT ON POTATO AND ICHATO FLANTS,
W70-09137
021 S GECLOGICAL SURVEY BEPCRT OF WATER RESOURCES RESEARCH, JULY 1, 1968 - JUNE 30, 1265. W70-09389 TRA HIGH VCITAGE
SHITCHING-SURGE CONSIDERATIONS IN UHV TRANSMISSION LINE
1251CN,
R70-09021 080 AFQUA RIVER
ESTUARY ENTRANCE, UMPQUA RIVER, OREGON HYDRAULIC MODEL
INVESTIGATION,
02L NTERGECUND CAVITIES
12AKAGE THECUGH EURIED CHANNEIS,
17C-09049 NDERGROUND POWERFLANTS
SPACE HEATING IN URBAN ENVIRONMENTS,
W70-09192 080 NEFRSEEFAGE FESTARCE INTO THREE-DIMENSIONAL SEEPAGE IN JCINTED FOCK FCUNDATIONS OF EIGH CAMS. N7C-09050 NIT ERCCESSES
-FCONOMICS OF CANNERY WASTE TREATMENT,
870-09338
OSD NITEE KINGLOM
APPLIED GEOFHYSICS IN THE NATURAL ENVIRONMENT BESFAFCH
CCUNCIL IN GREAT EFITAIN,
N70-09398
07B NATIONS
GEOPHYSICS IN UNITED NATIONS PROJECTS,
07B W70-09397 ICKES V FOX (INCREASED WATER RATES IMPOSED CONTRARY TO LAW). #70-09067 CKLAHOMA EX REL FHILLIPS V GUY F ATKINSON CO (INJUNCTION AGAINST DAM CONSTRUCTION). UNITED STATES W HILLOW RIVER POWER CO (IMPAIRED EFFICIENCY OF TYDROSLECTRIC FLANT CAUSED BY RAISING THE WATER IEVEL OF THE BIVER ON WHICH IT WAS LOCATED).

170-09073 WERDE RIVER IRRIGATION AND POWER DIST V SALT RIVER VALLEY WATER USERS' ASS'N (CCMIRACTUAL RIGHTS TO DAMSITE). W7C-C9083 WATER LAWS AND CONCEPTS, 1670-09131 UNITEE STATES V MCINTIRE (OWNERSHIF OF WATER RIGHTS ON INDIAN ESSEEVATION). 06R. 008. FIGOR FIAIN MAFFING BY THE U.S. GECLOGICAL SURVEY, W70-09255 UNITED STATES EX REL IVA V PCHELSON (CONDEMNATION WALUATION) - QGF

UNITED STATES V WAUNA TOLL BRIDGE CO (OBSTRUCTION OF NAVIGABLE RIVERS). 04A

UNITED STATES V OTLEY (OWNERSHIP OF LAKE BEDS) . N70-09467

BURLEY IRRIGATION DIST V ICKES (RIGHTS TO FROFIT FROM DAM OPERATION). #70-09472 03F UNIVERSITIES RESEARCH ON WATER QUALITY, W70-09348 09A UNSATURATED FLOW NUMBERICAL MODELING OF UNSATURATED GROUNDWATER PLOW AND COMPARISON OF THE MODEL TO A FIELD EXFERIMENT, W70-09107 02F A MOVING BOUNDARY MODEL OF A ONE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIENT POROUS FLOW SYSTEM, W70-09199 02G HYSTERFSIS IN TWO SANDS AND THE INDEPENDENT DOMAIN MODEL, $\ensuremath{\text{W70-05209}}$ THE TEREE-PHASE DOMAIN IN HYDROLOGY, W70-09260 HYDROPHYSICAL PROPERTIES AND MOISTURE REGIME IN THE UNSATURATED ZONE, W70-09261 AN APPROXIMATE METHOD FOR DETERMINING THE HYDRAULIC CONDUCTIVITY FUNCTION OF UNSATURATED SOIL, \$70-09342 02G ¥70-09342 UNSTEADY PLOW
SOME NUMERICAL METHODS FOR SOLVING PROBLEMS OF NON-SIEADY
SEPAGE IN NON-HOROGENEOUS ANISOTROPIC SOILS,
02G
02G UNSTEATY SIFPAGE
SOME NUMERICAL METHODS FOR SOLVING PROBLEMS OF NON-STEADY
SEEPAGE IN NON-HOMOGENEOUS ANISOTROPIC SOILS,
02G UPLIPI FRESSURE
A CRITICAL STUDY OF THE THEORIES CONCERNING UPLIFT IN HYDEAULIC STRUCTURES ON PERVIOUS FOUNDATIONS, \$70-09044
ORD URBANIZATION
WATER AS AN URBAN RESOURCE AND NUISANCE,
W70-09129
04C SOIL, WATER AND SUBURBIA. W70-09188 NEW YORK METROPOLITAN REGION--A MAJOF SEDIMENT SOUFCE, W70-09203 02J LEAD IN A SUBURBAN ENVIRONMENT, W70-09251 02K USES OF WASTE HEAT
USES OF WASTE HEAT,
W70-09193 INFLUENCE OF EVAPORATION FROM LAKE BAIKAL ON PRECIPITATION IN THE SURBOUNDING REGIONS, 02D 970-09096 CHEMICAL COMPOSITION OF PRECIPITATION IN REGIONS OF THE SOVIET UNION, #70-09133 CHARACTERISTICS OF PERMAPROST AND OF THE ACTIVE LAYER IN WEST SIBERIA, W70-C9257 EXPERIMENT IN THE LEACHING OF SALINE LAND IN SOUTHERN WATER BALANCE AND SILTING OF SMALL RESERVOIRS IN THE CENTRAL CHERNOZEM OF THE RUSSIAN SOVIET FEDERAL SOCIALIST REPUBLIC. W70-09312 INFILTRATION PROPERTIES OF THE SOILS OF THE CENTRAL CHERNOZEM PROVINCES, 02G ELEMENTS OF THE WATER BALANCE OF SMALL RESERVOIRS OF THE CENTRAL CHEFNOZEM PROVINCES, W70-09314 THE EALANCE METHOD OF COMPUTING SEDIMENT FLOW AND ESTIMATING THE FATE OF SILTING OF RESERVOIRS, 02.1 GEOPHYSICS IN PROSPECTING AND EXPLORATION FOR MINEFAL DEPOSITS IN THE U.S.S.R., N70-0333 MAP OF EVAPORATION FROM SMALL RESERVOIRS OF THE CENTRAL CHERNOZEM PROVINCES, W70-09413 WATER FROSION, THE FORMING OF SEDIMENT FLOW OF SMALL STREAMS IN THE CENTRAL CHERNOZEM PROVINCES AND MEASURES FOR PROTECTING RESERVOIRS FROM SILTING, SMALL RESERVOIRS AND PONDS OF THE CENTRAL CHERNOZER

670-09415 04A	THE TRINITY RIVI
TURBICITY OF FIVERS AND ITS DISTRIBUTION IN THE CENTRAL CHERNOZEH FFOVINCES, 570-05416	REQUIPEMENTS AND PEACH CANNERY W. W70-09183
CHARACTERISTICS OF SILTING OF SHALL BESERVOIRS OF THE CENTRAL CHERNOZEM PROVINCES AND COMPUTATION OF DENSITY OF ECTICE DEFCSITS, 870-09417 02J	EFFECTIVE PHOSPI ACTIVATED SLUDGE W70-05186
BYDROCHEMICAL CHARACTERISTICS OF SHALL RESERVOIRS IN SOME DISTRICTS OF THE CENTRAL CHERNOZEM RECVINCES,	REDUCING WASTE I W70-09187
птар	ODOR CONTROL MET
A PREDICTION EQUATION FOR VEGETATION EFFECTS ON WATER YIELD FROM WATERSHEDS IN ARID AREAS, R70-09361	IN-PLANT WASTE ! W70-09316
UTILIZATICH OF WASTE BEAT SFACE HEATING IN URBAN EBVIFONMENTS, W70-09192 08C	FILTRATION OF WAR W70-09317 POLYMER PLUS MAG
VALUE ENGINEFFING ENGINEFFING AND ECONOMIC EVALUATION STUDY OF REVERSE CSMCSIS,	SLURFIES, W70-09318 BAFFLED BIOLOGIC
\$70-09363 03A	W70-09320
GROUNGWATER VELCCITY FARTITION, W70-09227 02F	EFFECT OF RECIRC PEFFCFBANCE, w70-09321
VELOCITY DISTRIBUTION THE EFFECT OF BED-LOAD MOVEMENT ON THE VELOCITY DISTRIBUTION OF FICH, 670-09052 02J	EUROPEAN WASTE 1
VERBILION HARBOR WAVE ACTION AND BREAKWATER LOCATION, VERBILICS HARBOR, ORIO BYPRAULIC HODEL INVESTIGATION,	CATTLE SKIN TAND ACTIVATED SLUDGE W70-09324
W70-09178 08B WIRGINIA FICCO OF AUGUST 1969 IN WIRGINIA,	FLEXIFILITY REV FACILITIES, W70-09326
W70-09234 02E	CHARACTERISTICS W70-05327
COASTAL WFILANDS OF VIRGINIA-INTERIM REPORT, 670-09350 02L	TREATMENT OF DAI W70-09335
VISIBILITY ERCELEM A CONTRIBUTION TOWARDS THE REDUCTION OF ICE POG CAUSED BY HUHID STACK GASES AT ALASKAN FOWER STATIONS, W70-09172 05G	FCONCHICS OF CAN
WASHINGTON INLAND FOWER AND LIGHT CO V GRIEGER (FLCOD DAMAGE FROM NEGLIGENT DAM OPERATION).	TREATHENT AND SI OF ACTIVATED CAN W70-09339'
N70-09476 04A	THE ORIGIN AND O
WASTE ACTIVATED SLODGE BEDUCING WASTE ACTIVATED SLODGE VOLUME BY AMERORIOSTS, W70-09187 OSD	W70-C9340 EPFECT OF TOXIC WATEFCOURSES,
WASTE ASSIBILATIVE CAPACITY SELF-POBIFICATION OF NATURAL WATERS FROM CAREOHYDRATES, W70-09100 .05E	W70-09341 WATER TECHNOLOGY
CXIDATION OF AICCHOLS AND THEIR INFLUENCE ON THE SELF- EURIFICATION OF NATURAL WATERS,	W70-09361 PRELIMINARY WAT
W70-09401 05E	W70-09453
WASTE DISECSAL FLY ASH UTILIZATION CLIBELING STEADILY. W70-09040 08G	WASTE WATER (POLLU: EUROPEAN WASTE : #70-09322
HIW YORK BETROFCLITAN REGIONA MAJOB SEDIMENT SOURCE, W70-092C3	WASTES KINETIC ASPECTS W70-03506
IN-FLANT WASTE REDUCTION, W70-09316 05D	WATER ALLCCATION () ICKES V FOX (PRO
WASTE DURES ICHDCH EXTERSION MINING CO V FLLIS (CHNEESHIP OF ACCESTED LANCS)	PECERAL RECLAMATE W70-09479
W70-09465 WASIE BEA1	WATER ANALYSIS A MODIFICATION (ANALYSIS,
SPACE BEATING IN OBEAN ENVIRONMENTS, W70-09152 OBC	W70-09213
USES OF WASTE HEAT, W70-09193 03C	NITRATE VARIATION 70-09425
WASTE STOFAGE A STUDY OF FARM WASTE, FARM ABIMAL WASTE CHARACTERIZATION, HANCLING, UTILIZATION,	WATER BALANCE HYDROCHENICAL R RESERVOIR IN TH: W70-09098
W70-09426 05B	BETHOD FOR COMP
CCHERENNIVE WATER SUPPLY, SEWERAGE, SOLID WASTE AND AIR FOLLUTION CCNTROL PLANS, 870-C9450	W70-09103 FFFECT OF VARIA BALANCE AND ION
WASTE WATER DISFOSAL IN-FLAMI WASTE BEDUCTION, 870-09316 OSD	W70-09144 THE TERRESTRIAL
WASTE WATER TREATMENT	HANHONDII, W70-09146

```
QUALITY AND QUARTITY NANAGEMENT WITH RESPECT TO PLANNING 1 THE TEINITY RIVER BASIN,
                                             05G
                    COSTS OF ALTERNATIVE SYSTEMS FOR TREATING
                   HORUS REMOVAL BY THE AUDITION OF ALUE TO TR
                    PROCESS,
                   ACTIVATED SLUDGE VOLUME BY AMEROBICSIS,
                   THODS, EXPERIMENTATION AND APPLICATION, 05D
                   REDUCTION,
                   STE PLANT EFFLUENTS,
                                             05D
                   NETIC FIELD USED TO TREAT PARAMAGNETIC
                                             05D
                   CAL BASIS FOR TREATING POULTRY PLANT WASTESS
                   ULATION ON DEEP TRICKLING FILTER
                                             05D
                   NATER MANAGEMENT AND RESEARCH,
                   ERY WASTES TREATHENT IN A COMPLETELY HIXED D
                                            05D
                   TO DESIGN OF MACHINING PLANT'S TREATMENT
                  OF WASTEWATER AT DELHI. 05D
                   TRY HANURE BY LAGOONING, 05D
                   NERY WASTE TREATHENT, OSD
                   ODGE DISPOSAL OF WASTES FROM THE MANUPACTURE
                   CHARACTERISTICS OF TOXIC WASTES, WITH RENCE TO THE METAL INDUSTRIES, 05D
                   WASTES ON TREATMENT PROCESSES AND
                                             034
                   R AND WASTE HANAGEMENT PLAN. 05D
                   TION)
WATER HANAGEMENT AND RESEARCH,
05D
                   OF THE TREATMENT OF PHENOLIC WASTES, 05D
                   POLICY)
TECTION OF PRIVATE AFFROPRIATION SIGHTS IN FIGHT IN FIGHT OF PROJECT).
                   OF THE BENZENE SYNTHESIS METHOD FCF TRITION
                                         02K
                   N IN GROUNDWATER,
                   AGINE AND SALT BALANCE OF OTKAZNENSKIY
E FIRST YEAR OF ITS EXISTENCE (1966),
02K
                   UTING GROUNDWATER LEVEL FLUCTUATIONS,
                   TIONS IN SUBSTRATE SALINITY ON THE WATER IC COMPOSITION OF BEAN LEAVES,

021
                   SCOLOGY OF THE SPADEFCOT TOAD SCAFHIOPUS
HINEBAL METABOLISM OF HALOPHYTES,
```

70-09147

DIURNAL DISTRIBUTION FUNCTION FOR DAILY EVAPORATION, 70-09205

021

ATER VAFOR BALANCE OF THE ATMOSPHERE FROM FIVE YEARS OF EMISPHERIC DATA, 170-09238 028

NATER BUDGET OF UPPER KLAMATH LAKE SOUTHWESTERN CREGON, 170-09250 02H

MATER BALANCE AND SILTING OF SMALL RESERVOIRS IN THE CENTRAL CHEFNICER OF THE RUSSIAN SOVIET FEDERAL SOCIALIST REPUBLIC. 670-09312

ELEMENTS OF THE WATER BALANCE OF SMALL BESERVOIRS OF THE CENTRAL CHEFNOZEM FECVINCES, N70-09314

HYDROLOGICAL ABALYSIS OF VOLCANIC TERRANE THE RIO GRANDE DE SAN HIGUEL, EL SALVADOR, N70-09370 03B

TER CHEMISTRY
CHEMICAL COMPOSITION OF THE ICE OF CTRAZMENSKLY RESERVOIR,
\$70-09057

BYDROCHEMICAL REGIME AND SALT BALANCE OF OTKAZNENSKYY FESERVOIR IN THE FIRST YEAR OF ITS EXISTENCE (1966), 670-09098

FIEMENTAL SULFUE IN EDDY COUNTY, NEW MEXICO, \$70-09128

CHEMICAL COMPOSITION OF PRECIPITATION IN REGIONS OF THE SOVIET UNION, #70-69133

CHEMICAL CHARACTERISTICS OF WATER MASSES IN THE AMERASIAN EASTN OF THE ARCTIC OCEAN, W70-09230 02K

MEASUREMENT OF WATER FOTENTIAL AND CSMOTIC POTENTIALS IN SOIL WITH A COMBINED THERMOCOUPLE PSYCHROMETER AND SALINITY SENSOF, W70-09384

ATER CIRCULATION
SCHE EFFECTS OF FRESH-WATER INFLOW ON THE FLUSHING OF SOUTH
SAN FRANCISCO BAY A PRELIMINARY REPORT,
W70-09215
056

ECVEMENT OF STATED CRIFTERS IN THE SAN FRANCISCO BAY ESTUARY AND THE ADJACENT PACIFIC OCEAN A PRELIMINARY REPORT, \$70-09216 02L

ATER CONSERVATION
SEACE HEATING IN URBAN ENVIECNMENTS,
W70-09192

USES OF WASTE BEAT, W70-09193

ATER COOLING
SEACE HEATING IN URBAN ENVIRONMENTS,
170-09192

TSES OF WASTE HEAT, W70-09193 ATER COSTS ENGINEERING AND ECONOMIC EVALUATION STUDY OF REVERSE

CCHEFFIENSIVE WATER SUFFIY, SEWERAGE, SCIID WASTE AND AIR FCIIDIUS CCNTECI FLANS, 06B

WATER FICH ON USING A TIME VARIABLE INFILTEATION WITH THE ISRAELSON ECREEF IRRICATION EQUATION, W70-09141

ATER INJURY

EOPRINS V UPPER SCIOIO DRAINAGE AND CONSERVANCY DIST (NO
LAMAGES FOR INFROPER MAINTENANCE OF DRAINAGE DISTRICT'S
WATERWAYS).

WATER LAWS AND CONCEPTS, W70-09131

ATER LEVEL FLUCTUATIONS RETHER FLUCTUATIONS, DEFINED FOR COMPUTING GROUNDWATER LEVEL FLUCTUATIONS, 02F 870-09103

TIDAL PHENOMENA IN THE KARSTIC WATER LEVEL,

MARLISCH V UNITED STATES (CONDEMNATION OF PLOWAGE BASEMENT CYPE BIFARIANS'S LANDS) - 06F

WATER LEVELS
UNITED STATES V WABASHA-NELSCH ERIDGE CC (COMPENSATION FOR CONSEQUENTIAL CANAGES TO CONDEMNED RIGHT-OF-WAY).

670-09064

HYDRAULIC DESIGN FOR CHECK METHOD OF IRRIGATION, W70-09136

WATER MAINS
OLSEN V CITY OF DEARBORN (EVALUATION OF PROPERTY FARTIALLY
TAKEN FOR PUBLIC UTILITY PURPOSES).
W70-09491
062

WATER MANAGEMENT
PROCEEDINGS WORKSHIP ON MCSQUITO CONTROL IN NORTH CAROLINA,.
W70-09421
06G

WATER MANAGEMENT (APPLIED)
A MODEL OF WATER QUALITY MANAGEMENT UNDER UNCERTAINTY,
W70-09109
OGA

TIME BIAS IN RECREATION BENEFIT ESTIMATES, W70-09110

THE EROTECTION OF GROUNDWATER RESOURCES W70-09127 0

WATER QUALITY A CONCERN FOR AGRICULTURAL ENGINEERS, W70-09459 05G

ENVIRONMENTAL QUALITY. W70-09347

WATER FOILUTION
OPTIMAL RESOURCE ALLOCATION AND SOME TECHNIQUES OF
OPTIMIZATION,
W70-09182
056

EFFECT OF TOXIC WASTES ON TREATMENT PROCESSES AND WATERCOURSES,

WATER FOLIUTION CONTROL
BRITISH WATER POLLUTION CONTROL,
W70-09041

A HODEL OF WATER QUALITY MANAGEMENT UNDER UNCERTAINTY, W70-09109

THE FROTECTION OF GROUNIWATER RESOURCES. W70-09127

EFFECTIVE PHOSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE ACTIVATED SLUDGE PROCESS, W70-09186 O5D

SPACE HEATING IN URBAN ENVIRONMENTS, W70-09192

BOD MASS BALANCE AND WATER QUALITY STANDARDS, W70-09349

WATER POLIUTION EFFECTS
THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN CONCENTRATION IN THE DELAWARE BIVER,
05C

COMPOSITION OF WATER IN CLINCH RIVER, TENNESSEE RIVER, AND WHITFOAK CREEK AS RELATED TO DISPOSAL OF LOW LEVEL RADIOACTIVE LIQUID WASTES,

POLLUTION OF ESTUARIES, #70-09383

DETERGENIS, PHOSPHATES, AND WATER PCLIDTION, W70-09388 05C

RETAILOR BETWEEN THE "ITAL-ITAL" DISEASE AND THE POLIUTION OF RIVER WATER BY CADMIUM FROM A MINE, 05C

GIBSON V CITY OF TAMPA (POLLUTION OF CYSTER BEDS BY UNTREATED MUNICIPAL SEWAGE). 05B

WATER POLIUTION SOURCES
THE PROTECTION OF GROUNIWATER RESOURCES.
#70-09127
02F

THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXIGEN CONCENTRATION IN THE DELAWARE PIVER, 05C

COMPOSITION OF WATER IN CLINCH RIVER, TENNESSEE RIVER, AND WHITEOAR CREEK AS RELATED TO DISPOSAL OF LOW LEVEL RADICACTIVE LIQUID WASTES, W70-09194

DAVIS V CITIES SERVICE OIL CO (LIABILITY FOR DAHAGES CAUSED BY OIL SCILUTION).

BOD MASS BALANCE AND WATER QUALITY STANDARDS, 05a 05a

RELATION BETWEEN THE "ITAL-ITAL" DISEASE AND THE POLIUTION OF BIVES WATER BY CADMIUM FROM A MINE, 05C

```
CHEMICAL INCUSTRY, W70-09437
WATER FOTENTIAL EFFECT OF VARIATIONS IN SUBSTRATE SALINITY ON THE WATER EALANCE AND IONIC COMPOSITION OF BEAN LEAVES, &70-05144 021
WATER QUALITY FLANNING AND MANAGEMENT (FLANNING ESSENTIAL TO INSUEF WATER QUALITY),
   INSUBE WATER QUALITY), W70-09056
   SOME EFFECTS OF FRESH-WATER INFLOW ON THE PLUSHING CF SOUTH SAN FRANCISCO FAX A PRELIMINABY FEPORT, #7C-09215 05G
   UNIVERSITY BOLE IN ASTRONAUT LIFE SUPPORT SYSTEMS WATER RECOVERY SYSTEMS, W70-09236 05D
   WATERSHED HUMAN-USE LEVEL AND WATER QUALITY,
   DISSCLUED SCLIES-DISCHARGE RELATIONSHIPS
    670-09311
   BESEARCE ON WATER QUALITY, $70-09348
   A SYSTEE APERCACH FCF THE STUDY AND CONTROL OF FACTORS AFFECTING NATER FOLLUTION, N70-09422 05B
WATER QUALITY MARASEMENT

A HODEL OF WATER QUALITY MANAGEMENT UNDER UNCERTAINTY,

W70-09109 OGA
   ICKES V FOX (INCREASED WATER RATES IMPOSED CONTRARY TO LAW). W70-09067 06E
 WATER REDISTRIBUTION OF MOISTURE AFTER INFILTRATION IN DRY SOILS.
   INFLUENCE CF GRAVITY, W70-09299
NATER RESCUECES
CFTIMIZATION OF WATER RESOURCES SYSTEMS BY THE GRADIENT FROJECTION AND THE CONJUGATE GRADIENT METHODS,
   WATER AS AN URBAN RESCURCE AND NUISANCE, W70-09129 04C
   FECONNAISSANCE OF WATER RESOURCES IN THE HAINES-FORT CHIIRGET AFFA, AIASKA, W70-C9130 02E
   BYDROLOGY OF THE UPPER MALAD RIVER BASIN, SOUTHEASTERN
    W70-09132
                                                                02E
   RECCHNAISSANCE OF THE GROUNDWATER RESOURCES OF THE MISSOURI FIVER ALLUVIUM PETWEEN MIAMI AND KANSAS CITT, MISSOURI, W70-09249 02F $\rm cm^{-1}
   GBOUNDWATER BASIC DATA, FART 2 OF GEOLOGY AND GROUNDWATER FESOURCES OF MERCEB AND OLIVER COUNTIES, NORTH DAKCTA, $70-09367
   BYDRCLOGICAL BIELIOGRAPHY. W70-09376
                                                                  10
WATER BESCUBCES COUNCIL TASK PORCE REPORT

A TEST OF FEDERAL WATER FROJECT EVALUATION PROCEDURES WITH
EMPERSORS ON REGIONAL INCOME AND ENVIRONMENTAL QUALITY
DETROIT BIVER, IPENTON NAVIGATION CHANNEL,
876-69457
WATER RESCURCES DEVELOPMENT
WATER QUALITY FLANNING AND HANAGEMENT (PLANNING ESSENTIAL TO
INSURE NATER QUALITY),
W70-09056
05g
   THE PROTECTION OF GROUNDWATER RESOURCES. 670-09127
   FLABBING OUF FUTURE WATER RESOURCES, W7C-C9153
    COMMON EFFORS IN DEVELOFING A GROUNDWATER AQUIFER, N70-09225
    FEPCAT OF WATER BESOURCES RESEARCH, JULY 1, 1968 - JUNE 30,
   #70-09389
   GEOPHYSICAL FROSFECTING FOR GROUNDWATER IN THE SOVIET UNION, 670-09401
   INTEGRATION OF GEOPHYSICAL METHODS FOR GROUNDWATER EXPLORATION IN THE FRAIRIE PROVINCES, CANADA, 078
   INTEGRATION OF GEOPHYSICS AND HIDROGEOLOGY IN THE SCLUTION OF REGIONAL GEOUNDWATER PROFILERS, 07P
```

ALGAL CANCER AND CAUSAL SUBSTANCES IN WASTES FROM THE COAL

```
THE BOLE OF GEOPHISICS IN THE DEVELOPMENT OF THE WORLD'S GROUNDWATER RESOURCES,
   W70-09405
   THE USE OF GRAVINETER MEASUREMENTS IN MINING AND GROUNDWATE
   EXFLORATION,
W70-09408
WATER RESOURCES RESEARCH
REPORT OF WATER RESOURCES RESEARCH, JULY 1, 1968 - JUNE 301
1969.
W70-09389
09C
WATER BEUSE
USES OF WASTE HEAT,
970-09193
                                                                  03C
   UNIVERSITY ROLE IN ASTRONAUT LIFE SUFFORT SYSTEMS
                                                                                        WATER
   ESCOVERY SYSTEMS,
W70-09236
   FORAGE CROP IRRIGATION WITH OXIDATION POND EFFLUENT, W70-09423 05D
WATER FIGHTS
WATER LAWS AND CONCEPTS,
W70-09131
                                                                 06E
   UNITED STATES EX REL SIERRA LAND AND WATER CO VICKES (GOVERNMENT GRANTS OF RIGHTS-OF-WAY OVER PUBLIC LANDS POR IREIGATION SYSTEMS).
                                                                 03F
WATER SIGRAGE
ESTIMATING STORAGE CAPACITY IN DEEP ALLUVIUM BY GRAVITY—
SEISMIC METBODS,
W70-09373
02F
WATER STRUCTURE EQUIVALENCE OF ANOMALOUS WATER AND SILICIC ACID SCIUTIONS, 1970-09125 01A
   A BONCING MODEL FOR ANOMALOUS WATER,
WATER SUFPLY
CITY OF NEW YORK V NEW YORK WATER SERVICE CORP (CITY MAY
ORDER AN INCREASE IN WATER SUPPLY).
W70-09025
03D
   USES OF WASTE HEAT, W70-09193
    WATERSHED HUMAN-USE LEVEL AND WATER QUALITY,
   HYDROIGGICAL ANALYSIS OF VOLCANIC TERFANE
THE BIO GRANDE DE SAN MIGUEL, EL SALVADOR,
N70-09370 03B
                                                                            LOWER FASTN OF
   COMPREHENSIVE WATER SUPPLY, SEWERAGE, SOLID WASTE AND AIR POLLUTION CONTROL PLANS, W70-09450 06B
   PRELIMINARY WATER AND WASTE MANAGEMENT PLAN W70~09453
   HOLYCKE WATER POWER CO V AM WRITING PAPER CC (USE OF SATER FOWER PEXCHO SCOPE OF GRANT).

WYO-09475

06E
WATER TABLE
PREDICTIONS OF RESERVOIR LEAKAGE,
W70-09046
WATER TEMPERATURE
THE TEMPERATURE SELECTION OF SMALL HYPOPHYSECTOMIZED
GOLDFISH. (CARASSIUS AURATUS L.).
W70-09151
05C
   RESERVCIR EFFECT ON DOWNSTREAM WATER TEMPERATURES IN THE UPPER DELAWARE RIVER BASIN, USA 05A
    NOTES ON A THEORY OF THE THERMOCLINE, W70-09191
   MONTHLY MEAN SURFACE TEMPERATURES FOR LAKE ORIARIO AS DETERMINED BY ARRIAL SURVEY, 028
 WATER TREATMENT
CONTINUOUS COUNTERCURRENT ION EXCHANGE.
W70-09037
05F
    RADIOTRACER STUDIES ON RAFID SANC FILTRATION, W70-09091
   APPLICATION OF SPECIALIZED OPTIMIZATION TECHNIQUES FOR WATER QUALITY AND QUARTITY MANAGEMENT WITE FESPECT TO PLANNING FOR THE TRINITY RIVER BASIN, W70-05054
    TEW USERS BROOKS V UNITED STATES (JURISDICTION OF FEDERAL COURT TO DETERMINE WATER RIGHTS IN INTERSTATE FIVER). W70-09470 06E
 WATER CILITIZATION

EFFECT OF SOIL PROPILE TYPE AND PERTILIZER ON MOISIURE USE
BY WHEAT GROWN ON FALLOW OR STUBBLE LAND,
```

SUBJECT INDEX WAT-ZOO

W70-09139

UNITED STATES V MCINTIRE (OWNERSHIE OF WATER RIGHTS ON CHAPTER RIGHTS ON COLUMN REST OF COLUMN RIGHTS OF COLUMN RIGHTS OF COLUMN RIGHTS ON CHAPTER RIGHTS ON CHAPTE

TER YIELD IMPROVEMENT
TRANSPIRATION OF FONDEROSA FINE AND DOUGLAS FIR AFTER
TREATMENT WITE FRENZIMERCURIC ACETATE,
W70-09207
038

ATERFORI
A STUDY OF THE AQUATIC ECOSYSTEMS IN THO NATIONAL WATERFOWL
EFFOGES IN EISSISSIFFI,
E70-09346

2TERSHED MANAGERENI

ATERSHED MANAGEMENT
SCIL, WATER AND SUBURBIA.
W70-C9168
FLOOD SERIES FOR GAGED PENNSYLVANIA STREAMS.
02E

ATERSHED USE WATERSHED HUMAN-USE LEVEL AND WATER QUALITY, W70-09240 05E

ATERSHEDS (BASINS)
BUNOFF SYNTEESIS FOR RAIN-ON-SNOW BASIN,
W7C-09027
02E

EYDFCLOGY OF THE UPFER MALAD RIVER BASIN, SOUTHEASTERN ITABC, 02E

WATERSHED HUMAN-USE LEVEL AND WATER QUALITY, W70-09240

ATER-IEVEL FLUCTUATIONS

MATER-LEVEL AND WATER-QUALITY TRENDS IN AQUIPERS ALONG THE
RISSISSIFIF GUIF CCAST, 1970,

W70-09223

OZF

NATER-SOII HANAGEHENT SOIL, WATER AND SUBURBIA. W7C-C5188

NATER-USE EFFICIENCY

SFFECT OF SCIL PROFILE TYPE AND FERTILIZER ON MOISTURE USE
FY WHEAT GROWN ON PALLOW OR STUBBLE LAND,
6370-09139

03F

WAYES (WATER)
WAYE ACTION AND BREAKWATER LOCATION, VERMILICH HARBOR, OHIO
BYDRAULIC MODEL INVESTIGATION,
W70-09178
08B

WEATHER
CALCULATION OF RADIO NOISE LEVEL FOR THE DESIGN OF AC POWER
IRANSHISSICK LINES,
#70-09038
080

WEIGHABLE LYSIMETERS
COMPARATIVE STODY OF THE WATER BALANCE IN THE AERATED ZONES
WITH RADIO-ACTIVITE METHODS AND WEIGHABLE LYSIMETER,
W70-09263

WEILS NITRATE VARIATION IN GROUNDWATER, 09425

WEST SIBERIA
CHARACTERISTICS OF PERMAPROST AND OF THE ACTIVE LAYER IN
WEST SIBERIA,
W70-09257
02C

05A

WEST VIRGINIA

JAMES V DRAVO CONTRACTING CO (STATE'S RIGHT TO TAX FEDERAL
GOVERNMENT'S CONTRACTORS).
W7U-09064

06E

UNITED STATES V DICKINSON (GOVERNMENT'S LIABILITY FOR ERGSION CAUSED BY FLOODING). W70-09462 04A

UNITED STATES V WILLIS (LIABILITY FOR FLOOD DAMAGE). W70-09464 04A

WETLANDS
COASTAL WETLANDS OF VIRGINIA-INTERIM REFORT,
W70-09350
02L

WETTING HYSTERESIS IN TWO SANDS AND THE INDEPENDENT DOMAIN MODEL, 470 - 09209

REDISTRIBUTION OF MOISTURE AFTER INFILTRATION IN DEV SOILS.
INFLUENCE OF GRAVITY,
W70-09299 02G

WHEAT
THE STABILITY OF WHEAT EMBRYO GLUTAMATE DECARBOXYIASE UNDER
CONDITIONS OF WATER STRESS,
w70-09138
021

EFFECT OF SOIL PROFILE TYPE AND FERTILIZER ON MOISTURE USE BY WHEAT GROWN ON FALLOW CE STUBBLE LAND, W70-09139

WILD RIVERS
SCENIC RIVERS IN MARYLAND.
W70-09448
06

WISCONSIN
TROUT BROOK CO V WILLOW RIVER POWER CC (LIABILITY FOR DAM
PATLURE DURING UNPRECEDENTED PLOOD).
R70-09089

BLASK V SOWL (OWNERSHIP OF ISLANDS IN NAVIGABLE WATERS). W70-09175

TOWN OF WAUSAUKEE V LAUERMAN (LIABILITY FOR FLOOD CAMAGES). W70-09495 $04a$

WOOD DUCK
A STUDY OF THE AQUATIC ECOSYSTEMS IN TWO NATIONAL WATERFOWL
REFUGES IN MISSISSIPPI,
W70-09346
021

WRECK ACT
ERIE LACKAWANNA RY V SILLS (SUNKEN VESSEL OBSTRUCTING DOCKS
AS TRESPASS).

WYOMING
HYDROCARBONS IN THERMAL AREAS, NORTHWESTERN WYOMING,
W70-09108
02K

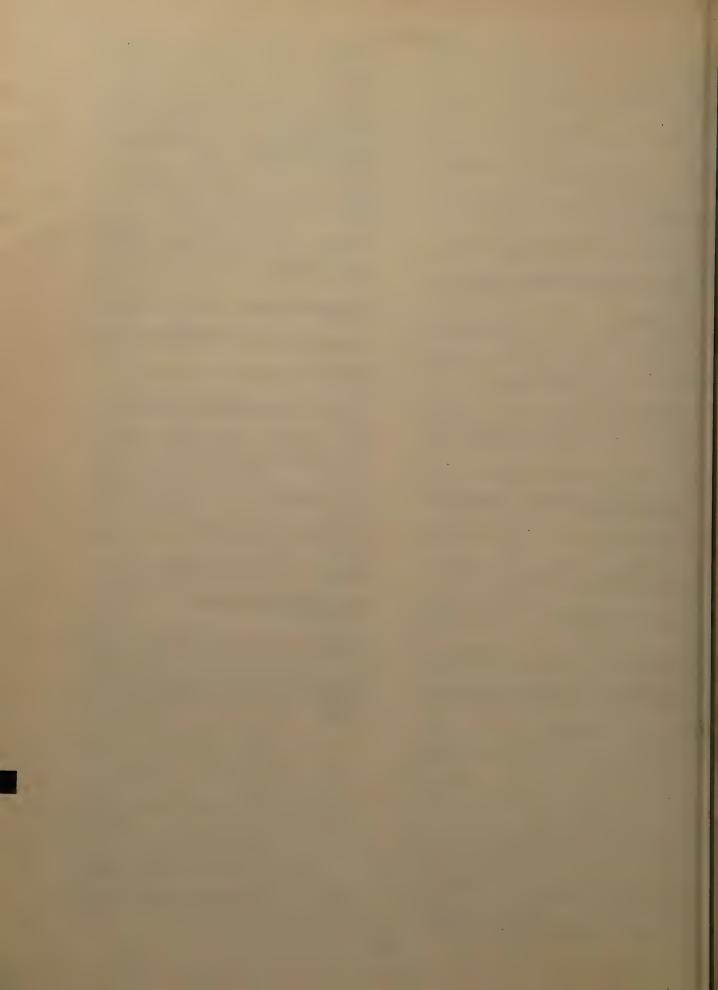
XEROPHILIC ANIMALS

HEART RATE AND CHANGES IN BODY FLUIDS IN AESTIVATING TOADS
PROM XERIC HABITATS,
1070-09148

021

YUGOSLAVIA
INFLUENCE OF SOIL STRUCTURE ON INFILTRATION AND PF VALUES OF
CHERNOZEM AND CHERNOZEMLIKE DARK HEADCW SOILS,
W70-09294
02G

ZOOPLANKTCH
PRELIMINABY RESULTS OF THE EXPERIMENTS ON THE TOXICITY OF
OIL COUNTERACTING AGENT (ESSO COREXIT 7664), WITH AND
WITHOUT IRAQ CRUDE OIL, FCR SELECTED BEBBERS OF MAKINE
PLANKICH,
170.004.78



AUTHOR INDEX

W70-09228

IES, J. B. SPILLWAY AND OUTLET WORKS, ROWLESBURG DAM, CHEAT RIVER, WEST VIRGINIA HYDRAULIC MODEL INVESTIGATION, W70-09160 CUEL-NOUE, AEDEL-SAZEK
A SYSTEM APPROACH FOR THE STUDY AND CONTROL OF FACTORS
AFFECTING WATER FOLIUTICH,
05B TAMSE, A. E.
RESPONSE OF DAIRY WASTE ACTIVATED SLUDGE TO EXPERIMENTAL
CONDITIONS AFFECTING PH AND DISSOLVED OXYGEN CONCENTRATION,
W70-09332 PRAMETERA, I. A.
INDIRECT METHOD FOR COMPUTING THE DURATION OF PRECIPITATION,
170-09106
02E ICALAY, B.
EYEROCASTING REVERSE OSMOSIS MEMBRANES,
E70-09246 03A TIEN, C.

DEVELOPMENT OF BEVEBSE OSMOSIS MEMERANES,

B70-09362

03A IIEN, JAMES E. FORACE CZOP IBRIGATION WITH CXIDATION POND EFFLUENT, W70-05423 OSD LIEN, LEIANC C.
A BONDING MODEL FOR ANOMALOUS WATER,
U70-09126 01A HEIN, MICHAEI
STOLY OF ERCSION IN HOADSIDE DRAINAGE CHANNELS IN NORTH
CAROLINA,
N70-09455 . 04A RECERSEN, L. J.
FUMFING TESTS AND HYDROGEOLOGICAL INVESTIGATIONS OF AN ARTESTAN ACQUIFEE NEAR HORSENS, LENHARK,
R70-09237

02F ABDEBSON, ERREST R.
NOTES ON A THEORY OF THE THERMOCLINE,
W70-09191 ANCERSON, JAMES A.

RUNOFF SINTERSIS FOR RAIN-ON-SHOW EASIN,

02E ANDERSCE, J. E. IFFECIS OF SUBLETHAL DDT ON A SIMPLE REPLEX IN BROCK TROUT, 670-09428 ANDERSCH, R. C.
AMMONIA TOXICITY IN SELECTED PISHES,
870-09430 ANNESTRANT, STIG A.
INSULATION LEVELS OF DC FILTER REACTORS AND RESISTOES FOR
BYCC POWER TRANSMISSION,
670-09016 ARCAN, I.
INFRAREC SPECIBOPHOICHETBIC STUDY OF WET CLAY SOILS AFFAA, F.
COMPARATIVE STUDIES OF THE MOLLUSCICIDAL EFFECT OF CUPROUS
CHICGIDE ANI COFFEE SULFAME IN IRAN,
05C ABEFLIGER, MARTIM E.

CHEMICAL CHARACTERISTICS OF WATER MASSES IN THE AMERASIAN FASTN OF THE ABETIC OCEAN,

870-C9230

02K ABBER, DAIE F.

3 STUTY OF THE AQUATIC ECOSYSTEMS IN THE NATIONAL WATERFOWL EFFUGES IN MISSISSIPPI,

870-09346

021 ASANO, SECJI AN ANALITICAL METHOD FOR EVALUATING THE SUSCEPTIBILITY OF FISE SPECIES TO AN AGRICULTURAL CHEMICAL (JAPANESE), W70-09433 ASBLET, ELWARD E-CEMBATICH AND MAINTENANCE OF LARGE HYDRO TUREINES - COLUMBIA AND SHAKE BIVERS, 97C-09047 ATRINS, F. R.
IFAC IN A SUBUREAN ENVIRONMENT,
#70-05251 ATTCE, C. J.
A STUTY OF FARM HASTE, PARM ABIMAL WASTE CHARACTEBIZATION,
BANCIINE, UTILIZATION,
W70-09426 EAILEY, J. W. LRAIN INSTALLATION FOR MITRATE REDUCTION,

EALDEN, A. R. FLEXIBILITY KEY TO DESIGN OF MACHINING PLANT'S TREATMENT BALLY, R. J. DETERMINATION OF THE COEFFICIENTS OF WATER MIGRATION THROUGH BANNISTER, R. G.
AQUIFER SIMULATION ON SLOW TIME RESISTANCE-CAPACITANCE BASEDOW, THIES EFFECT OF TEMPERATURE SHOCK ON THE TEMPERATURE RESISTANCE OF POIKILCTHERM AQUATIC ANIMALS. EXPERIMENTS ON THE FROSIEM OF HEAT AND COLD-HARDENING IN ANIMALS (GERMAN), W70-09436 BAUDCIN, F.
ELECTROMAGNETIC AERIAL SURVEY OF A FRESH WATER-SALT WATER
CONTACT IN THE RHONE DELTA (FRENCH),
078 BEALL, S. E. USES OF WASTE HEAT, W70-09193 BECHTELER, W.
HYDROLOGICAL SERIES AS A BASIS POR WATER RESOURCES POLICY,
W70-09387 EECKER, EDHARD R.

REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBYOSIS, W70-09187 05D BEGG, E. L.
AGE OF QUATERNARY SEDIMENTS AND SOILS IN THE SACRAMINTO AREA, CALIFORNIA BY URANIUM AND ACTINIUM SERIES DATING OF WEBTEEBATE FOSSILS, W70-09239

02J BELLPOST, B. P.
CONTEOL AND REPAIR OF CRACKS IN CONCRETE DAMS,
W70-09019 BELL, WIIIIAM E. WATER TECHNOLOGY, W70-09361 BENDIXEN, THOMAS W.

DEGRADATION OF WASTE WATER ORGANICS IN SOIL,

W70-09329

05E BENOIT, G. R.
FREEZING AND THAWING EFFECTS ON DRAINAGE,
W70-09380 02G BENTZ, A.
DIVERGENCES BETWEEN EXPERIMENTAL AND THEORETICAL VALUES OF
CAPILLARY DIFFUSIVITY (FRENCH),
W70-09285
02G BENYAMINI, Y..
POST-IRRIGATION MOVEMENT OF SOIL WATER 1. REDISTRIBUTION, 970-09124 BERTHOUEX, PAUL M.
ANALYSIS OF LAG PHASE BOD CURVES USING THE MONOD EQUATIONS, 470-09122 BESKIN, L. I.
NEUTRON MOISTURE METER FOR SALINE SOIIS,
W70-09268
078 BEWIRA, JATINDER K.
CHARACTERISTICS OF WASTEWATER AT DEIHI,
W70-09327
05D BHAGHAI, SURINDER K.
TREATMENT OF DAIRY MANURE BY LAGOONING,
W70-09335 BHATTACHAEVA, PROTOSH K.
AN ELECTRO-OPTICAL PROBE FOR MEASUREMENT OF SUSPENDED
SEDIMENT CONCENTRATION,
W70-09026
02J BHUITAN, S. I.

EFFECTS OF RAINFALL ON SETTLING VELOCITY OF SUSPENDED
SETTIMENT IN QUIESCENT WATER,
W70-09120

02J BIGGAR, J. W.
SOIL WATER DIFFUSIVITY AND WATER CONTENT DISTRIBUTION DURING
OUTFICH EXPERIMENT,
W70-05280
02G BLOOMFIELD, R. A.
AHHONIA TOXICITY IN SELECTED FISHES,
W70-09430 05C BOBER, E. S.

05G

AUTHOR INDEX BEK-CHA FINAL REFORT ON SEVERSE OSMOSIS MEMBRANES CONTAINING GRAFFITIC CRICE, 870-05245 FSTUARINE ENVIRONMENTS, W70-09424 ERCWN, V. M.
EFFECT OF TOXIC WASTES ON THEATMENT PROCESSES AND FCKEY, A. C.
TOXICITY STUDIES WITH AN CII-SPILL EMULSIFIER AND THE GREEN
ALGA FRASINCCLARUS MARINUS,
W70-09429
05c BRUCH, JCHN C., JR.
TWO-CIMENSIONAL DISPERSION EXPERIMENTS IN A POROUS MEDIUM,
W70-09123 02F BCFANDIKAF, H. V.
HICAOBIOLOGY OF A WASTE STABILIZATION POND, W70-05506 05D ERUUN, F.
USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING, ECFNSTEIN, J.
FREEZING ANI THAWING EFFECTS ON DEAINAGE, W70-09380 026 ¥70-09029 BUDYKO, M. I. REASONS FOR CLIMATIC CHANGES IN THE GEOLOGICAL PAST, W70-09102 BCFSHCHEVSKIY, YU. T.
COMPUTATION OF THE DEFORMATION OF EARS AND NAVIGATION BURD, RCNALD M.
WATER TECHNOLOGY,
W70-09361 038 ECUMER, WILLIAM J.
FROSICN CONTROL ON ROADSIDES IN TEXAS,
W70-09451 02J BUREJEVA, Z. H.
SOME NUMERICAL METHODS FOR SOLVING PROBLEMS OF NON-STEADY
SEFFACE IN NON-HOMOGENEOUS ANISCTROPIC SOILS,
W70-09309 02G BCWN, E. G. EOD AND COICE BEMOVAL FECH KRAFT HILL WASTES, N70-09330 05D EUREJEV, I. M.
SOME NUMERICAL METHODS FOR SOLVING PROBLEMS OF NON-STEADY
SEEPAGF IN NON-HOMOGENEOUS ANISOTROFIC SOILS,
W70-09369
02G BCYL, H. E.
SPILLRAY AND OUTLET WORKS, ROWLESBURG DAM, CHEAT RIVER, WEST
VIRGINIA HYDRAULIC MODEL INVESTIGATION,
670-09180 08B BURGOS, JUAN J.
HYDROLOGICAL CONSTANTS OF PAMPEAN SOILS BROWN PRAIRIE AND) EFALY, SILNEY O. IN-FLANT WASTE REDUCTION, W70-09316 BLACK FRAIRIE, W70-09287 BURKE, REWNETH B. S.
A REVIEW OF SOME PROBLEMS OF SEISHIC PROSPECTING FOR GROUNDWATER IN SURFICIAL DEPOSITS, W70-09402 07B EBANC, J. W. L. F. INTERNAL CATHODIC PROTECTION OF WATER COOLED PLANT, W70-09014 08C ERANSON, F. A.
FLANT COVER, RUNOFF, AND SEDIMENT YIELD RELATIONSHIFS ON BANCCS SPALE IN WESTERN COLCRADO,
W70-09118
O2J BURPELL, DAVID C.
CHEMICAL CHARACTERISTICS OF WATER MASSES IN THE AMERASIAN BASIN OF THE ARCTIC OCEAN,
W70-09230
02K EFASFEILD, C. W.
WAVE ACTION AND EREAKWATER LOCATION, VERMILION HARBOE, OHIO
HYDRAULIC MCDEL INVESTIGATION,
W70-09178
08E CALLAHAN, JAMES A.
WATER-LEVEL AND WATER-QUALITY TRENDS IN AQUIFERS ALONG THE
MISSISSIPPI GULF COAST, 1970,
W70-09223

02F RAUN, HEINZ E. ANALYSIS OF LAG FHASE BOD CURVES USING THE MONOD EQUATIONS, #70-09122 CAMPBELL, C. B.
A PREDICTION EQUATION FOR VEGETATION EFFECTS ON WATER HIELD PROM WATERSHEDS IN ARID AREAS, W70-09381 BRECENCET1, J. D.
LIGITAL ANALYSIS OF ABEAI FICW IN MULTIAQUIFER GROUNDWATER
SYSTEMS A QUASI THREE-DIMENSIONAL MODEL,
W70-09197 02F CAMPBELL, M. D.
A PREDICTION EQUATION FOR VEGETATION EFFECTS ON WATER YIELD FROM WATERSHEDS IN ARID AREAS, W70-09381 03B ERENNEMAN, COKALD R. WATER TECHNOLOGY, W70-09361 03A CAMP, J. D. FLCOD OF AUGUST 1969 IN VIRGINIA, W70-09234 EBEUER, G. D.
THE NEW BRUNSWICK ELECTRIC PCWEE COMMISSION SOLID STATESTATE HVDC ASYNCBROWOUS TIE INSTALLATION,
OBC CANABACHE, A.
INFILTRATION RATE AS RELATED TO HYDRAULIC CONDUCTIVITY,
HOISTURE DEFICIT AND OTHER SOIL PROFFETIES,
W70-09300 02G BEIDSSE, J. J.
GEOPHYSICAL PROSPECTING AND RESEARCH ON UNDERGROUND WATER BRCLOVOI, V. V.
GEOPHYSICS IN FRESPECTING AND EXPLORATION FOR MINEFAL DEFESTIS IN THE U.S.S.R.,
W70-09393 ELCGAN, TECHAS B.

EUSSIANS PUSE MAGNETORYDRODYNAMIC FCWER,

N70-09167 38C BRCCKS, KENNETH N.

1FAMSPIPATION OF PONDEROSA FIRE AND DOUGLAS FIR AFTER
1FEATHERY WITE PRENYINESCORIC ACFTATE,
W70-09207

03B

CAPON, A. STANLEY
CATHOCIC PROTECTION OF THE BONNEVILLE POWER ADMINISTRATION'SS
34.5 KV SAN JUAN ISLANDS CABLE,
N70-09013
08C

CARLSON, P. R.
SOME EFFECTS OF PRESH-WATER INFLOW ON THE FLUSHING OF SOUTH
SAN FRANCISCO BAY A PRELIMINARY BEFORT,
W70-09215
05G

HOVEMENT OF SEABED DRIFTERS IN THE SAN FRANCISCO BAY ESTUARY ONLY THE ADJACENT PACIFIC OCEAN A PRELIMINABLY REPORT, W70-09216

CARLSON, V.
INTEGRATION OF GEOPHYSICAL METHODS FOR GROUNDWATER
EXFLORATION IN THE PRAIRIE PROVINCES, CANADA,
H70-09403

CARTHEIGHT, KEROS
GROUNDWATER DISCHARGE IN THE ILLINOIS BASIN AS SUCCESTED BY
TEMPERATURE ANOMALIES,
W70-09201
02F

CASSEL, D. R.
SOIL WATER DIFFUSIVITY AND WATER CONTENT DISTRIBUTION DURING OUTFICE EXPERIMENT, W70-09280

02G

CESABIC, FRANK J.
TIME BIAS IN RECREATION BENEFIT ESTIMATES,
N70-09110 064

CHAMPAGNE, NORMAN E., JR.
A STSTEM FOR MEASURING TOTAL SEDIMENT YIELD FROM SMALL WATESBEDS,
W70-09121 02J

ERCNN, BABRY E.
A SYSTEM FOF MEASURING TOTAL SEDIMENT YIELD FROM SMALL NATIRSEES,
E70-09121 02J BECKN, J. H.
GEOPHYSICS IN UNITED NATIONS PROJECTS,
H70-09397 07B

BECNE, I. R.
THE EFFECT OF SALINITY ON THE OXIDATION OF HYDROCARBONS IN

PECUZES, F.
AUTCHATED ACTIVATED SLUDGE FLANTS WITH RESPIRATORY
PETABOLISH CONTECL,
W70-09502
05D

RCWH, ALEERT A BETROE FOR THE EVALUATION OF THE SYSTEM AND COST FFFECTIVENESS OF LARGE SEA WATER DISTILLATION PLANTS, 870-09247

AUTHOR INDEX CHA-DUN

AUDHRY, FAZAL H. TUREULENT DIFFUSION IN A STABLY STRATIFIED SHEAR LAYER, #70-C9173 08E

HEN, ISEN-TUC

EFFECTS OF SALIS AND ORGANIC MATERIALS ON THE HYDRAULIC

CCNUCCIIVITY OF THE SOILS,

\$70-09290

02G

EU, H I STUDY OF ERCSION IN BOADSIDE DRAINAGE CHANNELS IN NORTH CABCLINA, N70-09455

RU, K. Y.
CCMFARATIVE STUDIES OF THE HOLLUSCICIDAL EFFECT OF CUPROUS
CHICAIDE ANI COPPER SULFATE IN IRAN,
570-09432
05C

LAUSEN, E. E. CLIMATIC CSCILIATIONS 1200-2000 A E, W70-09224

CE, SCREET N.
BAJOR ELECTRIC FOWER FACILITIES AND THE ENVIRONMENT,
W70-09048
OGG

CLEMAN, REIL L. FLUME SIDDIES OF THE SEDIMENT TRANSFER COEFFICIENT, #7C-09119 02J

CIE, J. A.

MEASURING SOIL MOISTURE IN THE BRENIG CATCHMENT FRO
CF USING NEUTECN SCATTER EQUIPMENT IN SOIL WITH PEATY
1AYERS,
170-05264

026

CONNEIL, CERALD F.
ADVANCES IN HANDLING GAS CHLOFINE,
W70-09219

CONCHOS, 1. J.

SOME FEFFECTS OF FRESH-WATER INFLOW ON THE PLUSHING OF SOUTH
SAN FRANCISCO BAY A FRELIBINABY SEPORT,
05G

ECVEMENT OF SEASED DEIFTERS IN THE SAN FRANCISCO FAY ESTUARY AND THE ADJACENT FACIFIC OCEAN A PRELIMINABLY REPORT, W70-09216

CCCLEY, KHITH B.
INTEGY RELATICNSHIPS IN THE DESIGN OF PLOATING COVERS FOR
EVALCHATION REDUCTION,

COCHBS, HEWARI A. IFAKAGE THROUGH EURIED CHANNELS, %70-09049

04A

CCCFEE, HILTON B., JR.
A NUMERICAL TECHNIQUE FOR CALCULATING THE TRANSIENT POSITION OF THE SALTEATEE FRONT,
W70-09196

CCEPOCK, FAY
RESEARCH ON WATER QUALITY,
\$\int \text{W70-09348}\$

490

COBBETT, B. G.
1969 HVDC STRAY CURRENT TESTS ON UNDERGROUND TELEPHONE
CABLIS,
W70-09015
08C

COFFY, J. C.
A GAMMA-FHOTONEUTRON METHOD FOR LABORATORY STUDIES OF SCIL MATER, M70-09382

CCFK, H. F.
AN EMERGY BUDGET STUDY ABOVE THE FOREST CANODY AT MARMOT CREEK, ALBERTA, 1967,
170-05111

COEST, WALTER C.

HYDROIDCEICAL CONSTANTS OF PAMPEAN SOILS BROWN FRAIRIE AND
ELACK PEALERIE,
970-05287

026

COBY, R. I. FOILUTION OF ESTUARIES, W70-09383

COSTIN, J. B.
VISUAL CESEEVATIONS OF SUSPENDED-PARTICLE DISTRIBUTION AT
THREE SITES IN THE CARLETEAN SEA,
02J
470-09231

COUTANT, CHARIES C.
TEMEERATUBE, BEFRODUCTICS AND BEHAVIOR,
W70-0917C 05C

CCI, GERAIDIBE V.

THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN CONCENTRATION IN THE DELAWARE RIVER,

05C

CHAPTREE, KOBY T.
| NITRATE VARIATION IN GROUNDWATER, W70-09425

CHAPIREE, K.

A STUDY OF FARM WASTE, FARM ANIMAL WASTE CHARACTERIZATION, HAMELING, UTILIZATION, W70-09426 05B

CRAFT, T. F.
RADIOTRACER STUDIES ON RAPID SAND FILTRATION,
H70-09051 05F

CROFT, B. G.
GROUNDWATER BASIC DATA, PART 2 OF GEOLOGY AND GROUNDWATER
RESOURCES OF MERCER AND OLIVER COUNTIES, NORTH DAKCTÁ,
W70-09367

CUNNINGBAR, RICHARD R.
ELEMENTAL SULFUR IN EDDY COUNTY, NEW MEXICO,
W70-09128 02K

DABTRI, HASSAN NUMBERICAL MODELING OF UNSATURATED GROUNDWATER FLOW AND COMPAFISON OF THE MODEL TO A FIELD EXPERIMENT, W70-09107 02P

DAIDO, ATSUYUKI THE EFFECT OF BED-LOAD HOVEMENT ON THE VELOCITY DISTRIBUTION OF FICE, W70-09052

NFCRS, F.
CHANGES IN THE MOISTURE CONTENT OF THE TOPSOIL AS MEASURED WITH A NEUTRON MOISTURE GAUGE,

DANIEL, DONNIE L.
THE IMPORTANCE OF WATER RELATED ACTIVITIES AT STATE PARKS IN MISSISSIPEL.

DANSGAARD, W.
CLIMATIC OSCILLATIONS 1200~2000 A D,
W70-09224

DAVEY, JAMES F. 1969 HVDC STRAY CURRENT TESTS ON UNDERGROUND TELEFHONE CABLES, W70-09015

DAVIESCN, J. H.
SOIL WATER DIPFUSIVITY AND WATER CONTENT DISTRIBUTION DURING
OUTFLOW EXPERIMENT,
W70-09280
026

DAVIS, ERNST M.
ANIONIC AND MONIONIC SURFACTANT SORPTION AND DEGRALATION BY
ALGAE CULTURES,
W70-09438
05C

DAVIS, JAMES T. TOXICITY OF SELECTED HERBICIDES TO BIBEGILL SUNFISH, W70-09435

DE ECEVES, J.

COMPARATIVE STUDY OF THE WATER BALANCE IN THE ABRATED ZONES WITH FADIO-ACTIVITE METHODS AND WEIGHBLE LYSIMETER,

02G

DE BOODT, M.
COMPARATIVE STUDY OF THE WATER BALANCE IN THE AERATED ZONES
WITH RADIO-ACTIVITE METHODS AND WEIGHBLE LYSIGNTEF,
W70-09263

02G

DE GRYS, ANN A GEOCHEMICAL DRAINAGE SURVEY IN CENTEAL ECUAPOR, W70-09352 02K

DE JONG, E.

EFFECT OF SOIL PROFILE TYPE AND PERTILIZER ON MOISTURE USE
BY WHEAT GROWN ON FALLOW OR STUBBLE LAND,
W70-09139 O3F

DEBRINE, ERUCE E.
ELECTROLYTIC MODEL STUDY FOR COLLECTOR WELLS UNDER RIVER BEDS, W70-09210

DEGOPIK, I. YA.
HYDROCEEMICAL CHARACTERISTICS OF SMALL RESERVCIRS IN SOME
DISTRICTS OF THE CENTRAL CHERNOZEM FECVINCES,
W70-09419
02K

DICKEY, G. L.
DRAIN INSTALLATION FOR NITRATE REDUCTION,
W70-09228
05G

DICK, RICHARD I.
THICKENING CHARACTERISTICS OF ACTIVATED SIDDGE,
W70-05505

DIRASIAN, HENRY A.
FILTRATION OF WASTE PLANT EPPLUENTS,
W70-09317 05D

DORAN, JOHN J., JR.

ELECTRIC POWER - IMPACT ON THE ENVIRONMENT,
W70-09020

DUMITRIU, R.
INFILTRATION RATE AS RELATED TO HYDBAULIC CONDUCTIVITY,
HOISTURE DEFICIT AND OTHER SOIL PROFFETIES,
W70-09300 026

DUNHAM, K. C.

DUN-GCU AUTHOR INDEX

APPLIED GEOFFYSICS IN THE NATURAL ENVIRONMENT RESEARCH CCORCIL IN GERAT ESITAIN, N70-09398 07E

DUNN, CARFEL E.
GROUNTWATER VELOCITY FABILITION,
W70-09227 02

DURCZCY, G.
ELECTROMAGNETIC AERIAL SURVEY OF A FRESH WATER-SALT WATER
CONTACT IN THE RHONE DELTA (FRENCH),
W7C-09354

EATCH, GORDON P.

THE USE OF SEISHIC REFERENCION AND GRAVITY METHODS IN HYDROGECICGICAL INVESTIGATIONS, W70-09399

07B

ECKENFFIDEE, N. W., JR.

TREATMENT AND SLUDGE DISFOSAL OF WASTES FROM THE MANUPACTURE
CF ACTIVATEL CARBON,
W70-09339

05D

EIELING, J. A.
HANUAL CM SCLAR DISTILLATION OF SALINE WATER,
W7C-09244 03A

EICRBCLZ, GEOFFREY G.

FADIOTRACER STUDIES ON RAPID SAND FILTRATION,
W7C-C9091 05F

EISENHAUFE, BUGB R.
EUROFEAN WASTE WATER MANAGEMENT AND RESEARCH.
\$70-09322 05D

FIATA, C.

THE ETTERMINATION OF THE TRANSPORT COEFFICIENTS OF CELLULOSE ACETATE MEMEFANES, W70-09357

A COMPACTION THEORY FOR MODIFIED REVERSE OSMOSIS MEMBERANES, #70-05358

ELLIS, C. W. FICCD PIAIN MARFING BY THE U. S. GEOLOGICAL SURVEY, \$70-09255 06F

ELBICK, D. E.

THE MICROHYDROLOGICAL CHARACTERIZATION OF SOILS,
W70-09289 02G

EMELYANCY, V. A.

NEUTRON MOISTURE METER FOR SALINE SOILS,
W7C-C9268 07P

EMPETT, I. F.

BECONNAISSANCE OF THE GROUNDWATER RESOURCES OF THE MISSOURI FIVER ALLUVIUM BETWEEN MIAMI AND KANSAS CITY, MISSOURI, \$70-02249 02F

ENFIELD, CABL G.
F-N JUNCTIONS--A TOCI FCF TEMFERATURE MEASUREMENT, #70-09212 07E

ENKIS, C. E.
SUPERVISION, CONSTRUCTION AND EVALUATION OF A SEA WATER
LESUIFAILING FECCESS FILCT PLANT,
03A

FPSTEIN, EMANCEL
HINERAL METABOLISM OF HAIOPHYTES,
570-09147 023

PVINSON, D. E. ECONOMICS OF CANNERY WASTE TREATMENT, W70-09338 05D

FAEBICK, E.
IEVELOPPENT OF FEVEBSE OSMOSIS MEMEBANES,
W7C-09362 03A

FFLINSKY, V. V.
GEOPETSICS IN FROSPECTING AND EXPLORATION FOR MINERAL
LEPCSITS IN THE U.S.S.R.,
W70-09393
078

FECTORORY, A.
REDISTRIBUTION OF HOISTING AFTER INFILTRATION IN DRY SOILS.
INFLUENCE CF GRAVITY,
W70-09259
02G

PETCH, JOHN J.
ALVANCES IN HANCLING GAS CHICKINE,
W70-09319 05D

FILIPACHERA, HANNA FOLISH ISOTOFF AFFARATUS FOR RESEARCH OW SOIL HOISTURE, W70-09271 07B

FISACKERLY, G. H. ESTUARY ENTRANCE, UNFQUA ELVER, OREGON HYDRAULIC MCDEL INVESTIGATION, W70-09175 021

FISCHER, HUGC B.
IISPERSION IN HOMOGENEOUS ESTUARY FLOW,
W70-09217 021

FISEER, CEARLES E.

EUROFEAN WASTE WATER MANAGEMENT AND RESEARCH,

W70-09322

O5D

FLATER, H.
INTERFRETATION OF GEORLECTRICAL RESISTIVITY HEASUREMENTS POT SOLVING HYDROGEOLOGICAL PROBLEMS, W70-09409 07B

FLEMING, F. M. A DIURNAL DISTRIBUTION FUNCTION FOR DAILY EVAPORATION, W70-09205

FLOWERS, L. C.
FINAL REPORT ON REVERSE OSMOSIS MEMERANES CONTAINING
GRAFFITIC OXIDE,
W70-05245
03a

FOLDI, 1.

MEASUREMENT OF SOIL MOISTURE FROM THE TEMPERATURE GRADIENT,,
W70-09269

O7B

POLEY, H.

DEVELOPMENT OF REVERSE OSMOSIS HEMEBANES, W70-09362

03A

PORSH, I. F.

MAP OF EVAPORATION PROM SHALL BESERVOIRS OF THE CEBTRAL
CHERROZEM PROVINCES,
W70-09413

OZD

FRANKL, F. G. ABOUT THE ROUGHNESS PROBLEM IN PIFES AND TUNNELS, W70-09011 08B

FREUDENTHAL, PETER C.
STROBTIUM 90 CONCENTRATIONS IN SURFACE AIR NORTH ABERICA
VERSUS ATLANTIC OCEAN FROM 1966 TO 1969,
W70-05229
02B

PROLOV, V. YA

WATER EROSION, THE FORMING OF SEDIMENT FLOW OF SHALL STREAMS!
IN THE CENTRAL CHERNOZEM PROVINCES AND HEASURES FOR
PROTECTING RESERVOIRS FROM SILTING,
W70-C9414

02J

GABDNEE, W. R. POST-IRRIGATION HOVEMENT OF SOIL WATER 1. REDISTRIBUTION, W70-09124 02G

GASPAR, E. VALIDITY COMDITIONS OF THE FOIRT DISUTION HETHOD, 1170-05284 02F

GAUDY, A. F.
CONTROL MECHANISMS OPERATIVE IN A MATURAL MICROBIAL
POPULATION SELECTED FOR ITS ABILITY TO DEGRADE L-LYSINE, IX.
EFFECTS OF FRUCTOSE AND RIBOSE IN BATCH SYSTEMS,
W70-09336
OSD

GAUDY, A. F., JR.
CONTROL HECHANISHS OPERATIVE IN A NATURAL HICPOBIAL
POPULATION SELECTED FOR ITS ABILITY TC DEGRADE L-LYSINE,
III. FFFECTS OF CARBOHTDRATES IN CONTINUOUS-FLOW SYSTEMS
UNDER SHOCK LOAD CONDITIONS,
W70-05337

GELANKCY, V. A.
GEOPHYSICS IN PROSPECTING AND EXPLORATION POR MINEFAL DEPOSITS IN THE U.S.S.R.,
W70-05393
07B

GELBIUH, GIDEON
SUPERVISION, CONSTRUCTION AND RVALUATION OF A SEA WATER
DESULFATING PROCESS PILOT PLANT,
W70-09354
034

GEYEB, JOHN C.
AN EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM DESIGN, W70-09185

GILBERT, JEROME B.
WATER QUALITY PLANWING AND HANAGEMENT (FLANKING ESSENTIAL TO)
INSURE WATER QUALITY),
W70-09056
05G

GILDERBUS, PHILIP A.

EFFECTS OF DIQUAT ON BEUEGILLS AND THEIR FOOD OBGANISMS, W70-09431

OSC

GLOVER, JCHN E.
AN ELECTRO-OPTICAL PROBE FOR MEASUREMENT OF SUSPENDED SECTION CONCENTRATION, W70-09026
02J

GLOYNA, FARNEST F.
ANIONIC AND MONIONIC SURPACTANT SORPTION AND DEGRADATION BY
ALGAE CULTURES,
W70-09438
05C

GOLLAN, A. STOROCASTING REVERSE OSHOSIS MEMERANES, N70-09246 03A

GOOD, JOHN H.
HYDROCARBONS IN THERBAL AREAS, HORTEWESTERN WIGHING,
W70-09108

GOULDEN, F. D.
DETERGENTS, PHOSPHATES, AND WATER POLIUTION, W70-05388 05C

GOULD, JAMES P.

IATERAL ERESSURES ON BIGID PERMANENT STRUCTURES, N70-09045

RAIY, C. F. I.
CONTROL MECHANISMS OPERATIVE IN A NATURAL HICROFIAL
ECPULATION SELECTED FOR ITS ABILITY TO DEGRADE L-LYSINE, II.
EFFECTS OF FRUCTOSE AND RIBOSE IN BATCH SYSTEMS,
W70-09336

CONTROL MECHANISMS OPERATIVE IN A NATURAL MICROBIAL FORDIATION SELECTED FCR ITS ABILITY TO DEGRADE L-LYSINE, III. EFFECTS OF CAREOHYDRATES IN CONTINUOUS-FLOW SYSTEMS UNDER SEOCK LOAF CONDITIONS,

050

SEAHAM, F. W.
KINETIC ASPECTS OF THE TREATMENT OF PHENOLIC WASTES,
W7C-09566
O5D

STASS, L. B.

FRAIN INSTALLATION FOR NITRATE REDUCTION,

W70-09228

056

SEAVELAND, L. H.

MIGEATION OF SOLUBLE SALTS IN AN IRRIGATED FIELD IN RELATION
TO BAINFALL AND IRRIGATION,
B70-09140

03C

GREEN, DON W.
NUMBERICAL MCDELING OF UNSATURATED GEOUNDWATER FLOW AND
CCMFAEISON OF THE MODEL TO A FIELD EXPERIMENT,
870-09107

GEFEN, H. J.

MEASURING SOIL HOISTURE IN THE BRENIG CATCHMENT ERCBLENS
CF USING BEDTECN SCATTER EQUIPMENT IN SCIL WITH PEATY
IAYERS,
W70-09264

02G

GEIN, A. M.
INFILTRATION PROPERTIES OF THE SOILS OF THE CENTERI
CHERNCZE FECVINCES,
870-09313
02G

GRCSS, E. GFART MEN YORK METROFCLITAN REGION--A MAJOB SEDIMENT SOURCE, W70-09203 02J

GROVER, B. I.
A PREDICTION EQUATION FOR VEGETATION EPPECTS ON WATER YIELD FROM MATERSEDS IN ARID AREAS,
670-09381
O3B

GUNAJI, NABENIRA N.
LISPOSAL OF EBINE BY SOLAR EVAPORATION FIELD EXPERIMENTS,
670-09150 02D

GUNASERERA, D. A.
FOUNDATION SETTLEMENT AND GROUND REACTION CALCULATIONS USING A DIGITAL COMPUTER,
W70-09036
08D

GRIRN, WENDELL R. CALIERATION OF WALNUT GUICH SUPERCRITICAL FLUNES, 870-09218

HALAS, A. FACTORS AFFECTING SEED GERMINATION UNDER SOIL MOISTURE \$1RESS, \$70-09135

HAINDL, R.

ZONE LENGTHS OF AIR ENUISION IN WATER DOWNSTREAM OF THE RING
JUME IN FIFES,
670-09022

08E

BALEVY, E.
NUCLEAR TECENIQUES IN HYDROLOGICAL INVESTIGATIONS IN THE
UNSATURATED ZONE,
N70-09272
07B

HAIL, FRANCIS R.
LISSOLVED SCLIDS-DISCHARGE RELATIONSHIPS 1. BIXING PEDELS,
R70-09311

HAISTAD, C. H.
SEMAGE FLANT GRINDER FUMF,
W70-09446
05

BAMAN, Z.
EUNDING TESTS AND BYTROGEOLOGICAL INVESTIGATIONS OF AN
ARTESIAN AQUIFED NEAF HORSENS, LENHARK,
N70-09237
02F

HARSEN, ECHARC A.
A SYSTEM FOF HEASURING TOTAL SEDIMENT YIELD FROM SMALL BATTERSHELS, 02J 070-09121

HANSEN, R. O.
AGE OF CUATERNARY SECIMENTS AND SOILS IN THE SACRAMENTO
AREA, CALIFORNIA BY URANIUM AND ACTINIOM SERIES DATING OF
VERTIFIER ITE FORSILS,
E70-09239
O2J

BANDAMANDIU, V. EFFECT OF RECIRCULATION ON DEEP TRICKLING FILTER FERFCFHANCE, 670-09321 HARICASAN, M.
THE EFFECT OF TEMPERATURE ON WATER FICW IN SOILS, W70-09345 02G

HARLEMAN, DONALD R. F.
DISPERSION IN HOMOGENEOUS ESTUARY FLOW,
W70-05217 02L

HAPRISCN, I. J.

ELECTRONIC COMPUTER PROGRAM FOR HYDRAULIC ANALYSIS OF BOX CULVERTS (BPR PROGRAM HY-3),

W70-09445

HARRIS, F. L.
ENGINEERING AND ECONOMIC EVALUATION STUDY OF REVERSE
OSMOSIS,
W70-09363
03A

HAWKINS, E. H.

A GAMMA-EHOTONEUTRON METHOD FOR LABORATORY STUDIES CF SOIL WATER,

W70-09382

026

HAYES, G. S.
A PROPOSED STREAMFLOW DATA PROGRAM FOR MAINE, W70-09353 07A

HAZZAA, I. B.
DETERMINATION OF THE VELOCITY AND DIFFECTION OF GROUNDWATER FLOW EY RADIOISCTOPES, W70-09386 02F

HEEDE, EURCHARD H.

MORPHOLGGY OF GULLIES IN THE COLORADO ROCKY MOUNTAINS,

W70-09372

HEINRICE, RID
THE MCVEMENT OF WATER IN SANDY SOILS AFTER PLOUGHING AT A
DEPTH OF 50 CENTIMETERS,
W70-09303
02G

HEISING, CHARLES R.

PREDICTION OF RELIABILITY AND AVAILABILITY OF HVDC VALVE AND
HVDC TEBMINAL,
W70-09017.

HELVEY, J. D.
EFFECTS OF FOREST CLEAR-FELLING ON THE STORM HYDROGEAPH,
W70-09117

HEWLETT, JOHN D. EFFECTS OF FOREST CLEAR-FELLING ON THE STORM SYDROGRAPH, W70-09117

HILER, F. A.

EFFECTS OF RAINFALL ON SETTLING VELOCITY OF SUSPENDED

SECHENT IN QUIESCENT WATER,

W70-09120

02J

HILLEL, D. POST-IBRIGATION MOVEMENT OF SOIL WATER 1. REDISTRIBUTION, W70-09124

HINDS, JIM S.

ELEMENTAL SULFOR IN EDDY COUNTY, NEW MEXICO, W70-09128

HINESLY, THOMAS B.
DIGESTED SLUDGE DISPOSAL ON CROP LAND,
W70-09328
05D

HINGGRANI, MARAIN G.
INSULATION LEVELS OF DC FILTER REACTORS AND RESISTORS FOR HYDE POWER TRANSMISSION,
#70-09016
08C

TRANSIENT OVERVOLTAGE ON A BIPOLAR HVDC OVERHYAD LINE CAUSED BY DC JINE FAULTS, 870-09018 08C

HOBSON, GEORGE D.
SEISMIC METHODS IN MINING AND GROUNDWATER EXPLORATION, W70-09406

HOFFMAN, CARL E.

ENVISONMENTAL CRANGES PRODUCED BY COLD-WATER CUTLETS FROM
THREE ARKANSAS RESERVOIRS,
W70-09344

06G

BOFFMAN, 6. J.

MEASUREMENT OF WATER POTENTIAL AND OSMOTIC POTFNTIALS IN SOIL WITH A COMBINED THERMOCOUPLE PSYCHROMETER AND SALINITY SENSOF, W70-C5384

HOLLEY, EDWARD R.
DISPERSION IN HOMOGENEOUS ESTUARY FLOW,
W70-09217 021

HOLLIY, E. R.
TURBULENCE MEASUREMENTS NEAR THE FREE SURFACE OF AN CPRN
CHANNEI FICW,
W70-09208
02E

HORNEEGGE, CEORGE M.
A MOVING BOUNDARY MODEL OF A ONE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIEMT POROUS FLOW SYSTEM, W70-09199 OZG

HUBBARD, LARRY L. WATER BEDGET OF UPPER KLAMATH LARE SOUTHWESTEEN OFFICEN,

k7C-C9250

02H

HUGGINS, I. F.
AN APPROXIMATE METHOD FOR DETERMINING THE HYDRAULIC CONDICTIVITY FUNCTION OF UNSATURATED SQIL, W70-09382 02G

HUGHES, JABICE S.

TOXICITY OF SELECTED HERBICIDES TO BLUEGILL SUNFISH, W70-09435

PUPERBEYS, G. B.

INGINEERING AND ECONOMIC EVALUATION STUDY OF REVERSE CSMCSIS,

EDG_00262

HUNTER, RCBERT E.

CATTLE SKIN TANNERY WASTES TREATMENT IN A COMPLETELY MIXED ACTIVATE STUDGE FILCT FLANT, W70-09324 05D

INGVALSON, B. D.

MEASUREMENT OF WATER POTENTIAL AND CSMOTIC POTENTIALS IN
SOIL WITH A COMBINED THERMOCOUPLE PSYCHROMETER AND SALINITY
SENSOF,
W70-09384

026

IRBAY, S.
SOLUTIONS OF THE NON-LINEAR DIFFUSION EQUATION WITH A CRAVITY TERM IN BYDROLOGY, W70-09308 02G

ISAJI, TSUYCSEI
FIOW CF ENTFAINED AIR IN CENTRIFUGAL PUMPS, W70-09023 08C

ISAKABI, E.
LINGINFEFING AND ECONOMIC EVALUATION STUDY OF REVERSE CSMOSIS,
W70-69363 03A

ISBIC, E.
ALGAL CANCER AND CAUSAL SUBSTANCES IN WASTES FROM THE COAL CHEMICAL INIUSTRY,
870-09437
05C

IZATT, J. EFYAN
DISPERSION FREDICTION FROM CUFFENT METERS,
670-09219 02E

JACKSON, S.

EFFECT OF TOXIC WASTES ON TREATMENT PROCESSES AND
WATEFCOURSES,
W70-0934T

O5D

JEFFEBY, B. G.
FECONNAISSANCE OF THE GROUNDWATER RESOURCES OF THE MISSOURI FIVER ALLUVIUM BETWEEN HIAMI AND KANSAS CITY, MISSOURI, \$70-09245

JENKINS, SAMUEL H.
EBITISH WATER ECLIUTION CONTECL,
W70-C9041 OSD

JENSEN, B. L. THE EFFECT OF TEMPSHATURE ON WATER FLOW IN SOILS, $\alpha 70-09345 \\ 0.2G$

JCGANSEN, E. B.
THE THEFERTURE SELECTION OF SMALL HYPOPHYSECTOMIZED GOLDFISE, (CARASSIUS AURATUS 1.), B70-09151 OSC

JCENSEN, S. J.
CLIMATIC CSCILLATIONS 1200-2000 A D,
W70-09224 02

JOVEL, J. BCBERTC HYDROLOGICAL ANALYSIS OF VOLCANIC TERRANE LOWER BASIN OF TER RIO GRABLE DE SAN MIGUEL, EL SALVADOR, W70-09370

KAIBSKOFF, R. H.
ENEBGY AND EXDRAULIC TESTS ON MECHANICAL ABRATION SYSTEMS,
W70-09503

RALIMIN, 1A. C. EXPERIMENT IN THE LEACHING OF SALIME LAND IN SOUTHERN BAZAKHSTAN, W70-0925E 03C

KAIIN, C. C.
CROSSING THE SIEBRA MADRE FAULT ZONE IN THE GLENDOBA TUNNEL,
SAN GABELEI HCUMTAINS, CALIFCENIA,
W70-09031
08E

KAELIE, V. I.
SELF-PUEHFICATION OF NATURAL WATERS FROM CARBOHYDRATES, W70-09100 05B

CXIDATION OF AICCHOLS AND THEIR INFLUENCE ON THE SELF-FURTFICATION OF NATURAL WATERS, 870-05101 05P

KAYSEB, BCIF COMFARISON OF AFRATION EFFICIENCY UNDER PROCESS CONDITIONS, W70-09510 05D

KEALY, DONALD H.
A STUDY OF THE HYDROCHEMICAL FACIES OF THE WILCOX ACUIFERS
IN MISSISSIPPI,

W70-09095

KELLER, GEORGE V.

APPLICATION OF RESISTIVITY METHODS IN MINERAL AND
GROUNDHATER EXPLORATION PROGRAMS,
W70-09407

07B

KENNEDY, JCHN P.
AN ELECTRO-OPTICAL PROBE FOR MEASUREMENT OF SUSPENDED SEDIMENT CONCENTRATION, W70-09026

02J

028

RERR, G.
DETERGENTS, PHOSPHATES, AND WATER POLIUTION, W70-09388 05C

KEYES, C. G., JR.
DISPOSAL OF BRINE BY SOLAR EVAPORATION FIELD EXPERIMENTS, #70-09150

REYS, E. SCOTT
BOREHOLE GEOPHYSICS AS APPLIED TO GROUNDWATER,
W70-09400 07E

KILAMBI, RAJ V.
ENVIRONBENTAL CHANGES PRODUCED BY CCLE-WATER OUTLETS FROM
THREE ARKANSAS RESERVOIRS,
W70-09344
06G

KINNEY, PATRICK
CHEMICAL CHARACTERISTICS OF WATER MASSES IN THE AMERASIAN
BASIN OF THE ARCTIC OCEAN,
W70-09230
02K

KIRKHAB, DON
SOIL TEMPERATURE AND WATER CONTENT CHANGES DURING DRYING AS
INFLUENCED BY CRACKS A LABORATORY EXPERIMENT,
970-09379
026

RLEMES, V.
A TWO-STEP PROBABILISTIC MODEL OF STOFAGE RESERVOIF WITH CORRELATED IMPUTS, W70-09116

06A

KLOCK, JOHN W.

THE SEASONAL PERFORMANCE AND THE PATTERNS OF CHEMICAL HAN
BIOLOCICAL EVENTS IN SEWAGE LAGOONS,
W70-09333

THERMAL ENERGY CONSERVATION AND SEQUENTIAL BICIOGICAL PROCESSING APPLIED TO SEWAGE LAGOON DESIGN, W70-09334 05D

KLUME, FEED R.
SWITCHING-SURGE CONSIDERATIONS IN JHY TRANSMISSION LINE DESIGN,
W70-09021 08C

KLUTE, A.
HYDRAULIC AND PRESSURE HEAD HEASUREMENT WITH STRAIN GAUGE
PRESSURE TRANSDUCERS,
W70-09274
07B

ANALYSIS OF INFILTRATION INTO STRATIFIED SOIL COLUMNS, 870-09306 02G

KNAUER, GEORGE A.
A MODIFICATION OF THE BENZENE SYNTHESIS METHOD FOR TRITION ANALYSIS,
W70-09213
02K

KNETSCE, JACK L.
TIME BIAS IN RECREATION BENEFIT ESTIMATES,
W70-09110 06A

KNOP, E.
ENERGY AND HYDRAULIC TESTS ON MECHANICAL ABRATION SYSTEMS,
W70-09503
O5D

KOBAYASHI, H.
A THEORETICAL ANALYSIS AND NUMERICAL SOLUTIONS OF UNSATURATED FLOW IN SOIL, W70-09305

KOBAYASHI, J.
RELLATION BETWEEN THE "ITAI-ITAI" DISEASE AND THE PCLLUTION OF RIVER WATER BY CADMIUM FROM A MINE,
05C

KOHLHAAS, CHARLES ALBERT
THE OPTIMIZATION OF STORM-HOLDING TANKS
POLLUTION CONTROL,
W70-09181
05G

ROHL, R. E.
DESIGN AND CONSTRUCTION SYSTEM FOR THE DETERMINATION OF
TRANSPORT AND COMPACTION COEFFICIENTS OF REVERSE OSMOSIS
BEMBRANES,
W70-09356
03A

KOITZSCH, R.
DETERMINATION OF CAPILLARY COMDUCTIVITY AND DIFFUSIVITY OF SOIL IN SITU, W70-09282 026

KOLESHIKOVA, T. KH.
HICRCELEMENTS IN ATMOSPHERIC PRECIPITATION IN THE
OTHALMENSKIY RESERVOIR AREA,
W70-09099

O2B

KONDO, KAZUNOBU

KON-MAT

AUTHOR INDEX

AN ANALYTICAL METHOD FOR EVALUATING THE SUSCEPTIBILITY OF FISH SPECIES TO AN AGRICUITURAL CHEMICAL (JAPANESE), W70-09433

ONDRATYEV, E. M.
NEUTRON MOISTUFF METER FOR SALINE SCILS,
R70-09268
07B

OKCVAICY, G. S.
HICROELEMENTS IN ATMOSPHERIC PRECIPITATION IN THE
CIKAZNENSKIY RESERVCIE AFEA;
W70-09059 02B

CREMOVSKAYA, I. M.
CHEMICAL COMPOSITION OF THE ICE OF CTKAZNENSKIY RESERVOIR, \$70-09697 02K

CEGANCEF, A.

ON THE SOLUTION OF INVERSE PROBLEMS IN HYDROGEOLOGY (ERENCH),

N70-09371

02F

CORRIGIAN, IRA M. COLOR-VELCCITY METHOD IN MEASURING DISCHARGE, N70-05449 07E

CORNIYENKC, V. I.
INFLUENCE OF EVAPORATION FROM LAKE BAIKAL ON PRECIPITATION
IN THE SUBROUNTING REGIONS,
K70-09096
O2D

KOVALEY, YA. K.
TURBILITY OF RIVERS AND ITS DISTRIBUTION IN THE CENTRAL
CERROCZEM PEOVINCES,
670-09416
Q2J

KRAFT, GEFALD F.

FACTORS AFFECTING THE MOVEMENT OF WATER AND ORGANISMS WITHIN A REGULATED MULTIPURFOSE LAKE,

#70-09090 02H

KREMER, JAY G.
CLOS CONTROL METHODS, EXPERIMENTATION AND APPLICATION, 970-09190 05D

KBCCN, TJEEKE P. A GEOCHERICAL DEAINAGE SURVEY IN CENTRAL ECUADOR, #70-09352 02K

KULEYOSBOV, A. F.

THE EALANCE METHOD OF COMPUTING SEDIMENT FLOW AND ESTIMATING THE RATE OF SILITING OF BESERVOIRS, W70-09315

KOLANDRISTANY, V. C. A CRITICAL STUDY OF THE THEORIES CONCERNING UPLIFT IN HYDRAULIC STRUCTURES ON PERVICUS FOUNDATIONS, W70-09044

08D

KUNKEI, FRED SUMMARY OF GROUNDWATER OCCURRENCE IN CALIFORNIA, #70-09214

RUTILER, B.
ABALYSIS OF SOME FACTORS AFFECTING THE WATER WAPOUR LIFFUSION IN SCIIS, 02G 770-09295

LAFOREST, JAMES J.
SMITCHING-SURGE CONSIDERATIONS IN UNIT TRANSMISSION LINE
PLESIGN, ORC.

LANGUAY, C. C.
CILHATIC OSCILLATIONS 1200-2000 A D,

LABCCCA, S. A.

IRPATMENT AND SLUDGE DISPOSAL OF WASTES FROM THE HANUPACTURE
CF ACTIVATEL CABECN,
W70-09339

05D

LATIFF, S. A.

ERELIMINAST RESULTS OF THE EXPERIMENTS ON THE TOXICITY OF
CIL CCUMERACTING AGENT (ESSC CCREXIT 7664), WITH AND
WITHOUT IRAC CRUDE OIL, FOR SELECTED MEMBERS OF MARINE
FLANKTOR,
170.-1907.34

OSC

LEENBEER, J. A.
A KINETIC AND EQUILIBRIUM STUDY OF THE ADSORPTION OF THE CEGANIC INSECTICIDES CARBARYL AND PARATHION UPON SCRE SCIL CEGANIC MATTER SURFACES,

05A

LEE, E. S.

CPITHIZATION OF WATER RESOURCES SYSTEMS BY THE GRADIENT FEOJICIION ARE THE CONJUGATE GRADIENT METHODS, \$10-09092

LEE, E. R. FINAL REPORT ON REVERSE OSMOSIS MEMERANES COMMINING GRAFHITIC CHIDE, 870-09245

LEE, ECGEE D.

BATTERSHED BUMAN-USE LEVEL AND WATER QUALITY,
05B

LEGENTION OF GEOPHYSICAL METHODS FOR GROUNDWATER

EXFLCRATION IN THE PRAIRIE PROVINCES, CANADA, $\ensuremath{\text{W70-09403}}$

LENTZ, JCHN J.
AN EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM DESIGN,
W70-09185

LINER, G. B.
REQUIREMENTS AND COSTS OF ALTERNATIVE SYSTEMS FOR IFEATING PEACE CANNERY WASTES.
W70-09183
06C

LINK, J. B.
ELECTRONIC COMPUTER PROGRAM FOR HYDRAULIC ANALYSIS OF BOX
CULVERIS (BPR PROGRAM HY-3),
W70-09445
08A

LIU, S.

DEWELOPMENT OF REVERSE OSMOSIS MEMERANES, W70-09362

LLOYD, I. W.
RAPIC REVERSAL OF SAN LUIS PUMPING-GENERATING UNITS,
W70-09034.
ORC

LOEHMAN, FDNA T.
OPTIMAL RESOURCE ALLOCATION AND SOME TECHNIQUES OF OPTIMIZATION, w70-09182 05G

IOF, G. O. G.
MANUAL ON SOLAR DISTILLATION OF SALINE WATER,
W70-09244

LOPATIN, G. V.
SMALL RESERVOIRS AND PONDS OF THE CENTRAL CHERNOZER
PROVINCES, RSFSR,
W70-09415

DEVELOPING A METHOD OF COMPUTING SILTING OF SMALL RESERVOIRS IN THE CENTRAL CHERNOZEM FROWINCES, W70-09418

LOTH, WILLIAM D. DISPOSAL OF BRINE BY SOLAR EVAPORATION FIELD EXPERIMENTS, \$70-69150

LOVE, J. D. HYDROCARBONS IN THERMAL AREAS, NORTEWESTERN WYOMING, W70-09108

LCWE, B. A.
INTERNAL CATHODIC PROTECTION OF WATER COOLED PLANT,
1000-09014

LCME, R.
THE ORIGIN AND CHARACTERISTICS OF TOXIC WASTES, WITH
PARTICULAR REFERENCE TO THE METAL INDUSTRIES,
W70-09340
05D

LOW, P. F.
OBSERVATIONS ON ACTIVITY AND DIFFUSION COEFFICIENTS IN NAMONTHCRILLONITE,
W70-09105

LUNSFORE, JESSE V. DISPOSAL OF BRINE BY SOLAR EVAPORATION FIELD EXPERIMENTS, $\ensuremath{\text{W70-09150}}$

MABEY, CON R.
THE ROLE OF GEOPHYSICS IN THE DEVELOPMENT OF THE WORLD'S GROUNDWATER RESOURCES, 270-0405

HALEVICH, N. A.
COMPLEX EQUIPMENT FOR SINKING AND DRILLING OF VERTICAL
SHAPTS,
W70-09447
08H

MALINA, J. F., JR.
TREATMENT AND SLUDGE DISPOSAL OF WASTES FROM THE HANUFACTURE
OF ACTIVATED CARBON,
W70-09339
05D

MANJIKIAN, S.
DEVELOPMENT OF REVERSE OSMOSIS MEMERANES,
W70-09362

MASON, DAVID T.
FACTORS AFFECTING THE MOVEMENT OF WATER AND ORGANISHS WITHIN A REGULATED MULTIPURPOSE LAKE,
W70-09090 02H

HASSCUD, J.
COMPARATIVE STUDIES OF THE MOLLUSCICIDAL EFFECT OF CUPROUS
CHIORIDE AND COPPER SULFATE IN IRAN,
W70-09432

MATSUO, E.
IMPULSE DISCHARGE ON CONTAMINATED SUFFACE,
W70-09029 08C

HATVEEY, A. A. CHEMICAL HYDROLOGY OF REGIONS OF EAST ANTARCTICA, 02K 470-09134

MATZ, E.
HYDROCASTING REVERSE OSHOSIS MEMBEANES,
W70-09246
03A

AUTHOR INDEX

BAT-NIC LESIGN AND CONSTRUCTION SYSTEM FOR THE DETERMINATION OF TRANSPORT AND COMPACTION COEFFICIENTS OF REVERSE OSMOSIS THE CETTERMIKATION OF THE TRANSPORT COEFFICIENTS OF CELLULOSE ACTIATE MEMERANES, W70-09357 COMPACTION OF CELLULOSE ACETATE MEMBRANES, MAUCHA, L.
TIDAI PRENCHENA IN THE KARSTIC WATER LEVEL,
h70-09368 02F HCEFILE, I. J.
FOLYMER FILS HAGNETIC FIELD USED TO TREAT PARAMAGNETIC SIDERIES,
W7C-09318
05D HCCAVE, 1. B.
DEFOSITION OF FINE-GRAINED SUSPENDED SEDIMENT FROM TIDAL BCCCNAGHY, JAMES A.
BECONNAISSANCE OF WATER RESCURCES IN THE HAINES-FORT
CHILKCCI AREA, ALASKA,
W70-09120 02E HCCCY, E.
A STUDY OF FARM WASTE, FARM ANIMAL WASTE CHARACTERIZATION,
BANGLING, UTILIZATION,
W70-09426
05B MCCULIOCH, C. S.
SCHE PFFECTS OF FRESH-WATER INFLOW ON THE FLUSHING OF SOUTH SAN FRANCISCO PAY A PRELIMINARY BEPORT, 870-09215
05G BOVEHENT OF SEABED DEIFTERS IN THE SAN FRANCISCO BAY ESTUARY AND THE ATJACENT PACIFIC OCEAN A FRELIBINABLY REPORT, N70-09216 MCCULLY, WAYNE G.
FROSICH CONTROL ON ROADSIDES IN TEXAS,
W70-09451 02J MCGAUGH, J. L.
IFSALTING CCST CALCULATING FROCEDURES,
N70-09241 03A BCRENNA, G.
FCD ABD COLOR REMOVAL FROM KRAFT MILL WASTES, W70-09330 05D HCCUFFN, I. S.

CALIERATION AND EVALUATION OF A WIDE RANGE METHOD FOR MEASURING MCISTURE STRESS IN FIELD SOIL SAMPLES, 970-09273 MCWHCRIES, JCBW C. FCRAGE CRCP INFIGATION WITH OXIDATION POND EFFLUENT, W70-09423 05D MEFK, E. C.

TRAIN INSTALLATION FOR HITRATE REDUCTION, W70-C9228 05G MEIRE, W. I., JE.

APPLICATION OF SPECIALIZED OPTIMIZATION TECHNIQUES FOR WATER
COALITY AND QUANTITY MANAGEMENT WITH RESPECT TO FLANNING FOR
THE TRINITY RIVER BASIN,
NO-09054

OSG HEIRT, A.

EFFECT OF VARIATIONS IN SUBSTRATE SALINITY ON THE WATER
BALANCE AND ICHIC COMPOSITION OF BEAN LEAVES,
W70-09144 02I HEFCHFY, FCEFFT B.

TURFULENT DIFFUSION IN A STAPLY STRATIFIED SHEAR LAYER, W7C-09173

O8B BICRIUF, MASABORI TRACER STUDIES ON THE MOVEMENT OF SAND AND GRAVEL, 870-09024 023 BILANCY, ICCCF
AN INSTRUBERT FCE MEASURING SOIL MOISTURE BY MEUTRON SCATTLEING,
W7C-02465
07B BILLEE, A. J. SPACE HEATING IN URBAN ENVISONMENTS,

HILLER, E. M.
FICCD OF AUGUST 1969 IN VIRGINIA,
B70-09234

BILIER, L. KEITH
TEHERATORE-DEPENDENT CHARACTERISTICS OF PERIPHERAL MERVES
EXPOSED IC LIFFEERET THEBRAL CONDITIONS IN THE SAME ANIMAL,
N70-C9160
OSC

HILLER, R. P.
CALLERATION AND EVALUATION OF A WIDE RANGE METHOD FOR BEASURING MISSIONE STRESS IN RIELD SOIL SAMPLES, 670-09273

HOELLE, K. H. B.
ON GEOLOGICAL AND TECHNOLOGICAL ASPECTS OF ORIENTED N-SIZE
CORE DIAMOND DRILLING,
W70-09028
08E HOEPHAN, F.
COMPARATIVE STUDY OF THE WATER BALANCE IN THE AERATED ZONES'S
WITH RADIO-ACTIVITE METHODS AND WEIGHABLE LYSIMETER,
W70-09263
02G HOLDENHADER, W. C.
INFLUENCE OF RAINFALL ENERGY ON SOIL LOSS AND INFLITRATION
RAIES 2. EFFECT OF CLOD SIZE DISTRIBUTION,
W70-09378
026 MONEYMAKER, PERLEN C.
RESERVOIR LEAKAGE IN LIMESTONE TERRAINS,
W70-09042 04A HONKE, E. J.
AN APPROXIMATE HETHOD FOR DETERMINING THE HYDRAULIC CONDUCTIVITY FUNCTION OF UNSATURATED SOIL, W70-09382 02G MOORE, ROEERT E. WATER TECHNOLOGY, W70-09361 03A MORABIO, V. V. EQUIVALENCE OF ANOHALOUS WATER AND SILICIC ACID SOLUTIONS, W70-09125 MORRILI, B. A.
A PROPOSED STREAMFLOW DATA PRÓGRAM FOE MAINE,
W70-09353 07A NOTOC, E.
INFILITATION PATE AS RELATED TO HYDRAULIC CONDUCTIVITY,
MOISTURE DEFICIT AND OTHER SOIL PROFESTIES,
W70-09300 02G HULLIGAN, J. C.
HEASUREPENT OF THE THERBAL CONDUCTIVITY OF FROST BY A
TRANSIENT HOT-WIRE TECHNIQUE,
02C HUNK, WAITER H.
NOTES ON A THEORY OF THE THERMOCLINE,
W70-09191 OSB HUMM, R. E.
AN EMERCY EUDGET STUDY ABOVE THE FOREST CAMOPY AT HARHOT CREEK, ALBERTA, 1967,
H70-09111 02D BURAKASI, MITSUKIYO
FLCW OF ENTRAINED AIR IN CENTRIFUGAL PUMPS,
W70-09023 08C HORTY, V. V. M.
HYDRAULIC DESIGN FOR CHECK METHOD OF IRRIGATION,
W70-09136
OSF NAGABHUSHANAN, R.

BFFECT OF TEMPERATURE AND SALINITY ON THE HEAT TOLERANCE IN
THE HERRIT CEAB, DIOGENES BICRISTINANUS,
W70-09166

D5c GASABA, SUMIO AN ANALYTICAL METHOD FOR EVALUATING THE SUSCEPTIBILITY OF FISH SPECIES TO AN AGRICULTURAL CHEMICAL (JAPANESE), W70-09433 NAKAGABA, R.
ALGAL CANCER AND CAUSAL SUBSTANCES IN WASTES PRON THE COAL
CHERICAL INDUSTRY,
W70-09937
350 NATIONS, CLAUDE THE STABILITY OF WHEAT EMBRYO GLUTAMATE DECARBOLYLASE UNDER COMDITIONS OF WATER STRESS, W70-09138 NAUMAN, J. W. POLLUTION OF ESTUARIES, W70-09383 NAZAROV, G. V.
INFILTRATION PROPERTIES OF THE SOILS OF THE CENTRAL
CHERNOZEM PROVINCES,
W70-09313
02G NEMFROW, MELSON L.
BAFFLED BIOLOGICAL BASIS FOR TREATING POULTRY PLANT WASTES, W70-09320 05D NEUHAN, SHIOMO P.
FINITE ELEMENT METHOD OF ANALYZING STRADY SERPAGE WITH A
FRIE SURFACE,
W70-09198
02G ICECLS, J. D.
EVALUATION OF SOIL HOISTURE MEASUREMENTS IN OKLAHOMA AS SOIL
CHARACTERISTICS FOR CLASSIFICATION,
W70-09377

HILLS, B. EQUIVALENCE OF ANOMALOUS WATER AND SILICIC ACID SCIUTIONS;

AUTHOR INDEX NIE-PR

EXSEN, I. R.
SGIL WATER LIEPUSIVITY AND WATER CONTENT DISTRIBUTION DURING
CUTFICM EXPERIMENT,
W70-09280
02G

FUM, D. I. CN USING A TIME VARIABLE INFILTRATION WITH THE ISRAELSON ECRIFE IRRIGATION EQUATION, 670-05141 03F

SWOOD, EARL D. A STUDY OF THE AQUATIC ECOSYSTEMS IN TWO NATIONAL WATERPOWL REFUGES IN MISSISSIPPI, 870-09346 021

ILIVI, A. A. GEOPHYSICAL STUDIES IN PERMAPROST REGIONS IN THE U.S.S.E., #70-09396-07B

CEOFHYSICAL FROSPECTING FCR GROUNDWATER IN THE SOVIET UNION, W70-09401

HEART, RCEEFI D.

WATER ECONOMY OF THE GREEN-TAILED TOWHEE (CHLORURA
CHLORUBA),
470-09149

021

MCESCU, H. WALIDITY CONDITIONS OF THE POINT DILUTION METHOD, TTO-09284 02F 02F

FICE, G. T.
ECONOMICS OF CANNERY WASTE IDEALMENT,
E70-09338
05D

SEIGE, T.
IMPULSE DISCHARGE ON CONTAMINATED SURFACE,
N70-09039 08C

SIEF, J. L.

HEASUBEREBT OF WATER POTENTIAL AND OSMOTIC POTENTIALS IN
SOIL WITE A COMBINED THERMOCOUPLE PSYCHROMETER AND SALIBITY
SENSOF,
#70-09364

02G

OSWALT, N. H.

CPERATING FCRCES OW SECTOR GATES UNDER REVERSE HEADS
EYDRAULIC MCDEL INVESTIGATION,
08E

OTTENBARES, TECMAS E.
COLOR-VELCCITY HETHOD IN MEASURING DISCHARGE,
R70-09449 07E

OVERHAN, B. F. A CAMMA-FROTONEUTRON METHOD FOR LABORATORY STUDIES OF SOIL WATER, \$70-09382

OWEN, J. E.

FLANT COVEE, RUNOFF, AND SEDIMENT YIELD RELATIONSHIFS ON
HANCCS SHALE IN WESTERN COLCRADG,
W70-09118

02J

PALKER, MERVYN C.

DISPERSION FREDICTION FROM CUFRENT METERS,

N70-09219

02E

PAINTIFF, C. F.
CCNSERVATION OF CRAFT SKILLS IN DESIGN,
- 870-09033

PARDURANGA RAC, E. V.

EFFECTS OF EFFLUENT AND INFLUENT SEPRAGE ON THE HYDRODYNAMIC
FORCES ACTING ON AN ILEALIZED HONCCHESIVE SELIMENT PARTICLE,
W70-09410

PAFFALVI, F.

REDUCTION OF SEFFAGE LOSSES FROM IBRIGATION CANALS AS A RESOLT OF SILTING,

NTC-09043

FASVEEE, A-INVESTIGATION ON THE CONTROL OF FILAMENTOUS BULKING, 170-09509 05D

PATERSON, W. S. B.
THE PHYSICS OF GLACIERS,
R70-09412

FAVELRO, I. B.
HYDROCHERICAL REGIME AND SAIT BALANCE OF OTRAZNENSKIY
FESSEWOIR IN THE FIRST YEAR OF ITS EXISTENCE (1966),
\$70-09098

PAINE, C. MARSHALL CROSSING THE SIERRA MADRE FAULT ZONE IN THE GLENDORA TUNNEL, SAN GABEITEL MCUNTAINS, CALIFCRNIA, N70-09031

PECK, A. J.

FIRECT MEASUREMENT OF MOISTURE POTENTIAL A NEW TECHNIQUE,

#70-09275

DIFFUSIVITY DETERMINATION BY A NEW OUTFLOW METHOD, 870-09278

PECK, D. F.
FOLYMER FLUS MAGNETIC FIELD USED TO TREAT PARAMAGNETIC
SIGNALS,
670-69318

PEIXOTC, JOSE F.
WATER VAPOR BALANCE OF THE ATMOSPHERE FROM FIVE YEARS OF
HEMISFHERIC DATA,
W70-09238
028

PENNAN, H. L. THE ROLF OF VEGETATION IN SOIL WATER FROBLEMS, W70-09262 021

PETERKA, JOHN J.
WATER QUALITY IN RELATION TO FRODUCTIVITY OF LAKE ASHTABULA RESERVOIR IN SOUTHEASTERN NORTH DAKOTA, W70-09093

PETERSON, D. H.
SORE FFFECTS OF FRESH-WATER INFLOW ON THE FLUSHING OF SOUTH
SAN PEANCISCO BAY A PRELIMINARY REFCRY,
W70-09215
056

HOVEMENT OF SEABED DRIFTERS IN THE SAN PRANCISCO BAY ESTUARY AND THE ADJACENT PACIFIC CCEAN A PRELIMINARY REPORT, W70-09216

FETEBS, C. P.
HYDRAULIC AND PRESSURE HEAD MEASUREMENT WITH STRAIN GAUGE
PRESSURE TRANSDUCERS,
H70-05274
07B

PETRENCHOK, O. P.

CREMICAL COMPOSITION OF PRECIPITATION IN REGIONS OF THE SOVIET DWION, W70-09133

PHILIP, J. B.
A LINEARIZATION TECHNIQUE FOR THE STUDY OF INFILTRATION, W70-09307

ABSORPTION AND INFILTRATION IN TWO--AND THREE-DIMENSIONAL SYSTEMS, W70-09310

PHILLIES, W. E., JR.

THE EFFECT OF SALINITY ON THE OXIDATION OF HYDROCASPONS IN ESTUABINE ENVIRONMENTS, 05B

#70-09424

PICKERING, R. J.
COMPOSITION OF WATER IN CLINCH RIVER, TENNESSEE RIVER, AND
WHITTOAK CREEK AS RELATED TO DISPOSAL OF LCW LEVEL
RADIOACCIVE LIQUID WASTES,
W70-09194
05B

PIERCE, JAMES C., JR.

AERATED LAGOONS TREAT SECONDARY EFFLUENT,
W70-09331

PINDER, GECRGE P.
A NUMERICAL TECHNIQUE FOR CALCULATING THE TRANSIENT FOSITION
OF THE SALTWATER PRONT,
W70-09196

PINDER, C. F.
DIGITAL ANALYSIS OF AREAL FLOW IB MULTIAQUIFER GROUNDWATER
SYSTEMS A QUASI THREE-DIMENSIONAL MODEL,
W70-09197 02F

PIVNICKA, JOSEPH R.

RFFECTIVE PHOSPHORUS REMOVAL BY THE ADDITION OF ALUM TO THE
ACTIVATED SLUDGE PROCESS,
W70-09186

FLUHCUSKI, E. J.
HYDROLGY OF THE UPPER MALAD RIVER BASIN, SOUTHEASTERN IDAHC,
R70-09132

POLJARCEF-MAYBER, ALEXANDRA REFECT OF VARIATIONS IN SUBSTRATE SALINITY ON THE WATER BALANCE AND IONIC COMPOSITION OF BEAN LEAVES, W70-09144 021

FOLKOWSKI, L. B.
A STUDY OF FARM WASTE, FARM ARIMAL WASTE CHARACTERIZATION,
HABBIING, UTILIZATION,
W70-09426

POPEL, JOHANNES
PHOSENORUS REMOVAL WITH FERRIC IRON AND ALUMINUM,
W70-09507
05D

POPOVICS, SANDOR A REVIEW OF STRESS-STRAIN RELATIONSHIPS FOR CONCRETE, W70-09032

PORTEOUS, ANDREW
A CONTRIBUTION TOWARDS THE REDUCTION OF ICE FOG CAUSED BY
HUMIL STACK GASES AT ALASKAN POWER STATIONS,
W70-09172
05G

03F

PRASHAR, C. R. K.
PADDY PATOONS,
W70-09501

PREHN, W. L., JR.
DESALTING COST CALCULATING PROCEDURES,
#70-09241 03A

PREISER, H. S.
HYDROCASTING REVERSE OSMOSIS MEMBRANES,
W70-09246

PRILI, ROBERT NUMERICAL MCDELING OF UNSATURATED GROUNDWATER FLOW AND COMPARISON OF THE MODEL TO A FIELD EXPERIMENT,

FRINS, B. E. FFFECTS OF SUBLETHAL DDT ON A SIMPLE REFLEX IN BROCK TROUT, &70-09428

FRECTOR, CONAID E.

TREATMENT OF DAIRY MANUER BY LAGOONING,
W70-09335

FECCICE, E. J.
CROSSING THE SIERRA MADRE FAULT ZONE IN THE GLENDOFA TUNNEL,
SAN GABRIEL MCUNTAINS, CALIFORNIA,
E70-09031
08E

RAPFIDCE, B. 8.
DIRECT MEASUREMENT OF MOISTURE POTENTIAL A NEW TECHNIQUE, W70-09275

RAEI, G. S. THE PFFECT OF TEMPERATURE ON WATER FLOW IN SOILS, $1770\!-\!02345$

RAMASWAMY, T. N.
A CRITICAL STUDY OF THE THEORIES CONCERNING UPLIFT IN EYDRAULIC STRUCTURES ON PERVIOUS FOUNDATIONS, K70-09044 08D

RAMBY, EVERETI B.
STOLY OF THE USE OF AERIAL AND SATELLITE PHOTOGRAMMETRY FOR SURVEYS IN HYDECICGY,
W70-09454
07B

BABLIES, S. I.

MEASUREHENT OF WATER PCTENTIAL AND CSMOTIC POTENTIALS IN
SOIL WITH A COMPINED THERNOCOUPLE PSYCHROMETER AND SALINITY SENSCE, W70-09384

EVES, J. K. EFFFCTS OF THERMAL DISCHARGE FROM THE SAN ONOFRE NUCLEAR GENERATIRG STATION,

REICH, E. M.
FICCD SERIES FOR GAGED FENNSYLVANIA STREAMS,
02E

FEMSON, IEWIN
A HOVING BOUNDARY MODEL OF A ONE-DIMENSIONAL SATURATED-UNSAIDBATED, TRANSIENT FORGUS FLOW SYSTEM,
026

RENNIE, D. A. FFFECT CF SCIL PROFILE TYPE AND FEBTILIZZE ON MOISTURE USE FY WHEAT GROWN ON FALLOW OR STUBBLE LAND, N70-09129

REYNOIDS, G. ENGINEERING AND ECONOMIC EVALUATION STUDY OF REVERSE CSMCSIS, W70-09363

RICE, JAMESK.

RATER TECHNOLOGY,

W70-09361

03A

RINGLEE, SCHEET J.
FREIZCTION OF SELIABILITY AND AVAILABILITY OF HVDC VALVE AND
HVDC TERMINAL,
W7G-09017
08C

RITTEE, J. B.
A SUMMARY OF PELLIMIBARY STUDIES OF SEDIMENTATION AND
EXPRECION TE POLINAS LAGOON, HARIN COUNTY, CALIFORNIA,
W70-09235

ECEECK, GCECON G.
WATERSHED HOBAN-USE LEVEL AND WATER QUALITY, W70-09240 05E

BCEERTS, GEORGE D.
FREDICTIONS OF RESERVOIR LEAKAGE,
W70-09046

BCCKHCCD, DAVID E.
RUNOFF SYBTHESIS FOR RAIN-OB-SNOW FASIN,
87C-09027
02E

RCIE, A. A.

BY DROPHYSICAL PROPERTIES AND HOISTURE REGIME IN THE
LNSATURATED ZCKE,
W70-09261

02G

THE NATURE OF THE MINIMAL WATER RETENTIVE CAPACITY, W70-09302

RCIG, VIEGILIC
THE TEPRESTEIAL ECOLOGY OF THE SPADEPOOT TOAT SCAPHIOPUS HAHHONDII,
W70-09146
02G

RCSE, I. A. WATER TRANSFORT IN SOTLS BY EVAPORATION AND INFILTRATION, #70-09276 02D

ROSTEN, L.

DETAILING BY COMPUTER, W70-09035

08F

ROTEM, J.

THE EFFECT OF SOIL MOISTURE LEVEL OF THE INCIDENCE OF FARLL BLIGHT ON POTATO AND TOHATO PLANTS, W70-09137

ROY, A. W.
THE TEMPERATURE SELECTION OF SHALL HYPOPHYSECTOMIZED GOLDFISH, (CARASSIUS AURATUS L.),
W70-09151 05C

RUIBAL, P.
THE TERRESTRIAL ECOLOGY OF THE SPADEFOOT TOAD SCAPFIOFUS HAHRONDII,

RUSHTON, R. R. AQUIFER SIMULATION ON SLOW TIME RESISTANCE-CAPACITANCE NETWCRKS, #70-09226

RYDER, F. H.
THE NEW BRUNSWICK ELECTRIC POWER COMMISSION SOLID STATE-STATE BYDC ASYNCHROMOUS TIE INSTALLATION.

SABIS, WILLIAM R.
COMPREHENSIVE WATER SUPPLY, SEWERAGE, SOLID WASTE AND AIR
FOLLUTION CONTROL PLANS,
W70-09450 . 06B

SAGI, R.
INFILTRATION IN TERMS OF SOIL MOISTURE, RAIN INTENSITY AND DEFTH OF RAINFALL,
W70-09301
02G

SAROJINI, R.
EFFECT OF TEMPERATURE AND SALINITY ON THE HEAT TOLFFANCE IN M
THE HERMIT CRAB, DIOGENES BICRISTIMANUS,
W70-09166
05C

SARVARY, I.

TIDAL PRENOMENA IN THE KARSTIC WATER LEVEL,

W70-09368

02F

SAUCIER, R. I.
ACOUSTIC SUBBOTTOM PROPILING SYSTEMS, A STATE-OF-THE-ART SURVEY, W70-09176

SAWADA, Y.
CALCULATION OF RADIO MOISE LEVEL FOR THE DESIGN OF AC POWER TRANSMISSION LINES,
W70-09038
08C

SCHEILEGGER, ADRIAN E.
STOCHASTIC HODELS IN HYDROLOGY,
W70-09115

SCRIBUSENER, PAUL E. WATER QUALITY A CONCERN FOR AGRICULTURAL ENGINEERS, W70-09499 05G

SCHMID, A. ALLAN
A TEST OF FEDERAL WATER PROJECT EVALUATION PROCEDURES WITH
EMPHASIS ON REGIONAL INCOME AND ENVIRONMENTAL QUALITY
DETROIT RIVER, TREBTON NAVIGATION CHANNEL,
03E

SCHWEIDER, WILLIAM J.
WATER AS AN URBAN RESOURCE AND NUISANCE,
W70-09129 04C

SCHWCB, HARLAN H. FLCODS IN IOWA, W70-09254

SCOTT, DAVID H.
COMPRESENSIVE WATER SUPPLY, SEWERAGE, SOLID WASTE AND AIR
POLLUTION COMTROL PLANS,
W70-09450
06B

SCOTT, GORDON D.
RHEOLOGICAL AND ULTINATE STRENGTH PROFERTIES OF COHESIVE SOILS, #70-09452

SFITZ, E. G.
RAPID REVERSAL OF SAN LOIS PUMPING-GENERATING UNITS,
W70-09034 08C

SELEZNEVA, E. S. CHEMICAL COMPOSITION OF PRECIPITATION IN REGIONS OF THE SOVIET UNION, W70-09133

SELIM, H. N
SOIL TEMPERATURE AND WATER CONTENT CHANGES DURING DRYING AS
INFLUENCED BY CRACKS A LABORATORY EXPERIMENT,
W70-09379 02G

SESTRICH, D. E.
FINAL REPORT ON REVERSE OSMOSIS MEMERANES CONTAINING
GRAPHITIC OXIDE,
W70-09245
03A

SHAKIROV, A. A. COMPUTATION OF BARS AND NAVIGATION CHANNELS,

\$70-09256 02J

ACVA, I. G. SELF-PURIFICATION OF NATURAL WATERS FROM CAREORYDRATES, W70-09100 05B

AFIRC, JOSEFH A STATEMENT ON PROSPHORUS, 1070-09325

05D

ABP, H. E.
STREAM CEDEF AS A MEASURE OF SAMPLE SOURCE UNCERTAINTY,
1070-09202 02J

NATTLES, DONALD E. WATER-LEVEL AND WATER-QUALITY TRENDS IN AQUIFERS ALONG THE BISSISSIFFI GULF COAST, 1970, U2F

HIFTAN, 2. L. INTEGRATION OF GEOPHYSICS AND HYDROGEOLOGY IN THE SOLUTION OF BEGIONAL GEOUNDWATER PROBLEMS, 07E

HIR, C. S.
AFFLICATION OF SPECIALIZED OPTIMIZATION TECHNIQUES FOR WATER
QUALITY AND QUANTITY HANAGEBENT WITH RESPECT TO FLANNING FOF
THE TRINITY RIVER BASIN,
#7C-09094

056

HEOLYANSKAYA, N. A. CHARACTERISTICS OF PERMAPROST AND OF THE ACTIVE LAYER IN MEST SIEERIA, W70-09257 02C

INF, I.

DIVERGENCES BETWEEN EXPERIMENTAL AND THEORETICAL VALUES OF CAPILLARY DIFFUSIVITY (FEENCE),

W70-05285

02G

GROUNDRATER RECORDS OF SOUTH CAROLINA - 1966, H70-09411 02F

SKAGES, R. W.

AN APPROXIMATE HETHOD FOR DETERMINING THE HYDRAULIC COMBUCTIVITY FUNCTION OF UNSATURATED SOIL, W70-09342

SHABT, J. S.
USE OF IOPOICGIC INFCRMATION IN PROCESSING DATA FOR CHANNEL HETHEREKS,
07C

SHERDON, E. T.

EFFECTS OF BAINFALL ON SETTLING VELOCITY OF SUSPENDED

SEDIMENT IN QUIESCENT WATER,

W70-09120

02J

SMITH, ALVIN I., JE.
A SELECTED ANNOTATED BIBLIOGRAPHY OF ENVIRONMENTAL STUDIES
CF PCIANC,
870-09456
02B

SMITH, DAVID E.
COMPRESENSIVE WATER SUPPLY, SEWERAGE, SOLID WASTE AND AIR
FULUTION CONTROL FLANS,
870-09450
068

SMITH, E. LINECOD
WATER ECONOMY OF THE GREEN-TAILED TOWNEE (CHLORUBA
CHLCEURÁ),
H70-09149
021

SCHOLCVA, L. F.
CXIDATION OF ALCOHOLS AND THEIR INFLUENCE ON THE SELFFUBLIFICATION OF NATURAL WATERS,
W70-05101
O5B

SOFCKIN, I. N.
ELEMENTS OF THE WATER BALANCE OF SMALL BESERVOIRS OF THE
CENTRAL CHEFNOZEN FROVINCES,
870-09314
02H

SOSENITZ, EEN LIGESTEC SLUDGE DISPOSAL ON CROF LAND, W70-C9328

SOVERI, JCUKO
ON THE AFRESICH OF FORE WATER IN PINNISH ARGILLACEOUS
SEDIMENTS OF DIFFERENT AGE,
02G
070-09195

SEANGLER, C. F.
ESTIMATING STORAGE CAPACITY IN DEEP ALLUVION BY GRAVITYSEISEIC METECDS,
870-09373

SPICKA, IVAN FUCTUATION OF EFFLUENT QUALITY IN ACTIVATED SLUDGE PLANTS, 05D 070-09504

SFECUL, CIS 1.
CATTLE SKIR TANNERY WASTES TREATMENT IN A COMPLETELY MIXED ACTIVATEL SLUDGE PILOT PLANT,
05D
#70-09324

STAIRS, C. N.
THE NEW BRUNSWICK ELECTRIC POWER COMMISSION SOLID STATE-STATE HYDE ASSECTED HOUS TIE INSTALLATION, W7C-09012 STAKMAN, W. P.
DETERMINATION OF PORE SIZE BY THE AIR BUBBLING PRESSURE
METHOD,
MICHOGORY
07B

THE RELATION BETWEEN PARTICLE SIZE, PCRE SIZE AND EYDRAULIC CONDUCTIVITY OF SAND SEPARATES, W70-09298

STAROSCISZKY, O.
REDUCTION OF SEEPAGE LOSSES FROM IRRIGATION CANALS AS A
RESULT OF SILTING,
W70-09043
03P

STEARNS, BOB
HEAT WASTE,
W70-09162 05B

STEPP, J. M.
NEQUIREMENTS AND COSTS OF ALTERNATIVE SYSTEMS FOR TREATING PEACE CANNERY WASTES.
W70-09183
06C

STILES, NEWELL T.

ISOPACHOUS MAPPING OF THE LOWER PATURENT ESTUARY SECTIMENTS
BY CONTINUOUS SEISHIC PROFILING TECHNIQUES,

170-03390 021

STOCK, G. W., JR.
GROUNDWATER RECORDS OF SOUTH CAROLINA - 1966,
W70-09411 02F

STONE, J. F.
EVALUATION OF SOIL MOISTURE MEASUREMENTS IN OKLAHOMA AS SOIL
CHARACTERISTICS FOR CLASSIFICATION,
W70-09377
026

STORRS, PHILIP N.
WATER QUALITY PLANNING AND MANAGEMENT (PLANNING ESSENTIAL TO INSURE WATER QUALITY),
W70-09056
05G

STORE, D.
AN ENERGY BUDGET STUDY ABOVE THE POREST CANOPY AT MARMOT CREEK, ALBERTA, 1967, W70-09111 02D

STRANGE, W. E.
THE USE OF GRAVIMETER MEASUREMENTS IN MINING AND GECUNDRATER
EXFLCRATION,
W70-09408
076

STRCH, E. G.
RAPID REVERSAL OF SAN LUIS PUMPING-GENERATING UNITS,
#70-09034 08C

SUBCASKI, WAYNE J.
IMPROVEMENT OF TUBULAR CELLULOSE ACETATE MEMBRANES IN FEED
ACETIIVES,
W70-09248
03A

SUDNITSIN, I. I.
SOIL MOISTURE PRESSURE IN SOME CLIMATIC ZONES,
W70-09291 02G

SUFFIRE, HAKARU
FLOW OF ENTRAINED AIR IN CENTRIFUGAL FUMPS,
W70-09023
08C

SYMONS, JAMES M.
WATERSHED HUMAN-USE LEVEL AND WATER QUALITY,
W70-09240
05B

SZIGNAETO, Z.
REDUCTION OF SEEPAGE LOSSES FROM IRRIGATION CANALS AS A RESULT OF SILTING, W70-05043

SZONYI, I. MEASUREMENT OF SOIL MOISTURE FROM THE TEMPERATURE GRADIENT, #70-09269 07B

TAIGANIDES, E. PAUL
AGRICULTURAL WASTES AND THE ENVIRONMENT,
W70-09498

TAKAGI, SHUNSUKE
AN ANALYSIS OF ICE LENS FORMATION,
870-09114
020

TALBERT, S. G.
MANUAL ON SOLAR DISTILLATION OF SALINE WATER,
W70-09244
03A

TALSMA, T.
HYSTERESIS IN TWO SANDS AND THE INDEFENDENT DOMAIN MODEL,
W70-09209
02G

TARASOV, H. H. CHEMICAL COMPOSITION OF THE ICE OF OTRAZMENSKIY RESERVOIR, 02K 970-05097

HYDROCHEMICAL REGIME AND SALT BALANCE OF OTKAZNENSKIY RESERVOIE IN THE FIRST YEAR OF ITS EXISTENCE (1966), W70-09098

TAYLOR, L. E.
PLANNING OUR FUTURE WATER RESOURCES,
W70-09153
06B

IFE-WBI	AUS
THELS, BILLY B. A STUDY OF THE ACOUNTIC ECOSYSTE FERUGES IN MISSISSIFFI,	
W70-09346	021
TENNENT, B. C. ELECTRONIC CONFUTER PROGRAM FOR	HYDRAULIC ANALYSIS OF BOX
CULVERIS (PER EBCGBAM HY-3), 870-09445	CSA

TERNISCH, J. E.

The EFFECT OF SALINITY ON THE OXIDATION OF HYDROCARBONS IN
ESTUBRINE ENVIRONMENTS,

W70-09424

05B

TEVIS, LICID, JR.
THE TERFESTRIAL ECOLOGY OF THE SPADEFOOT TOAD SCAPHIOPUS HAMBORII, 100-09146 02G

THIBUBURTEL, E.

ECD AND COLOR REMOVAL FROM KRAFT MILL WASTES,

W70-09330 05D

THOMPS, HAROLT E.
WATER AS AN URBAN RESOURCE AND NUISANCE,
W70-09129 04C

WATER LAWS AND CONCEFTS, W70-09131 06E

THOMAS, RICHARD E.

DEGRADATION OF WASTE WATER ORGANICS IN SOIL,
W70-09329 05E

THEGUE, EAVID B.

TRANSPIRATION OF PONDERGNA FINE AND DOUGLAS FIR AFTER THEATHENT WITE PHENYLHERCURIC ACETATE, B70-09207

03B

TCETZ, DATE W.

FXPERIMENTS ON THE ADSORPTION OF AMMONIUM IONS BY CLAY
FAPTICES IN NATURAL WATERS,

170.0531

TCIE, JCHK E.
UNIVERSITY FOLF IN ASTRONAUT LIFE SUFFORT SYSTEMS WATER
FFCCVFFY SYSTEMS,
W70-09256
05D

TCILAN, ARNE EXPERIENCES WITH SNCW PILLOWS IN NGRWAY, W70-09375 02C

TCPIAIN, J.
AN ENERGY EDDGET STUDY ABOVE THE FOREST CANOPY AT MARMOT CEFER, ALEEFTA, 1967, W70-09111 02D

TBAYERST, W. J.

LETERGENIS, PHOSPHATES, AND WATER POLLUTION, W70-C9388 05C

TROMBLE, JOHN B.
F-N-JUNCTIONS--A TOOL FOR TEMPERATURE MEASUREMENT, N70-09212 07E

TSUCHIYA, YOSHITC
TBACER STUDIES CW THE MOVEMENT OF SAND AND GRAVEL, 670-09024
02J

TGLIB, M. F. FYDECCASTING BEVERSE OSMOSIS MEMBRANES, #70-09246 03A

TORMER, J. S. EBOYANT FLUMES AND THERMALS, E70-C5166 0

TYBONIUK, N.
APPLICATION OF BEGRESSION ANALYSIS IN HYDROLOGY,
N70-09391 07C

UFICH, CHARLES
A HCCEL OF WATER QUALITY HANAGEMENT UNCER UNCERTAINTY, W70-09109 06A

05F

020

UTABL, H.
ELECTROPAGNETIC AERIAL SURVEY OF A FRESH WATER-SAIT WATER
COMMACT IN THE BHONE DELTA (FRENCH),
B70-09354
07B

VACHAUD, GEORGES
VERTFICATION OF THE GENEFALIZED DARCY'S LAW AND
LETTERHINATION OF CAPILLARY CONDUCTIVITY AT THE BEGINNING OF
HCRIZONAL INFILITATION (FRENCH),
W70-09266
02G

VACHUAL, GEORGES
A STUDY OF BEDISTRIBUTION AFTER THE FINISH OF HOBIZONTAL INFLITBATION (FRENCH),
W70-09304
02G

VAN EAVEL, C. B. M.
TEE THREE-PEASE COMAIN IN HYDROLOGY,
W70-09260 027

VAN HYLCKAMA, T. E. A. HATER USE BY SALY CEDAR, N70-09113 VASA, JIRI SOME METHODS FOR THE DETERMINATION OF SOIL MOISTURE AND BALANCE HEASURING, 07B

VEMURI, NARASIMHAMURTY
ON THE SYSTEMS APPROACH IM HYDROLOGY,
R70-05385 02A

VEHURI, VENKATESWARARAO ON THE SYSTEMS APPROACH IN HYDROLOGY, W70-09385 02A

VENETIS, C.
A NOTE ON THE ESTIMATION OF THE PARAMETERS IN LCGARITHMIC
STAGE-DISCHARGE RELATIONSHIPS WITH ESTIMATES OF THEIR ERROC
W70-05374
022

VERMA, A. P.
FINGER INDIBITION IN ARTIFICIAL REPLEBISHMENT OF GROUNDWATT
THROUGH CRACKED POROUS HEDIUM,
W70-09200

02F

VETTERLEIN, E.
A STUDY ON PRESSURE MEMBRANE PROPERTIES IN RELATION TO CAPILLARY CONDUCTIVITY MEASUREMENTS, W70-09279 02G

VIRTA, J.

THE DETERMINATION OF SOIL HOISTURE WITH THE NEUTRON SCATTERING METHOD IN FINLAND,
W70-09267

O7B

VISSER, H. C.
THE RELATION BETWEEN LITHCLCGICAL FRCFERTIES AND THE SHAPE!
OF THE DESCRIPTION CURVE,
W70-09288
02G

AN EMPIRICAL EXPRESSION FOR THE DESORPTION CURVE, W70-09292 02G

VOL'FISUM, I. V.
HETHOR FOR COMPUTING GROUNDWATER LEVEL FLUCTUATIONS, W70-09103 02F

VREUGDENHIL, C. B.
TWO LAYER HODEL OF STRATIFIED PLOW IN AN ESTUARI, W70-05152 02L

VUCIC, M.

INFLUENCE OF SOIL STRUCTURE ON INFILITATION AND PP VALUES OF CHERNOZEHLIKE DARK HEADEN SOILS, W70-05234 O2G

WALLACE, D. E.
ESTIMATING STORAGE CAPACITY IN DEEP ALLUVIUM BY GRAVITYSEISHIC METHODS,
W70-05373 02F

WAILICK, EDWARD I.
A MODIFICATION OF THE BENZENE SYNTHESIS METHOD FOR TRITIUB AWALYSIS,
W70-09213

WALLIS, GRABAN B.
A CONTRIBUTION TOWARDS THE REDUCTION OF ICE FOG CAUSED BY
BUHIL STACK GASES AT ALASKAN POWER STATIONS,
W70-09172
056

WARD, WILLIAM
A TEST OF FEDERAL WATER PROJECT EVALUATION PROCEDURES WITE
EMPHASIS ON REGIONAL INCOME AND ENVIRONMENTAL QUALITY
DETROIT SIVEE, TREBTON MAVIGATION CHANNEL,
W70-09497
03E

WARRICK, A. W.
SOIL WATER DIFFUSIVITY AND WATER CONTENT DISTRIBUTION DURING OUTFLOW EXPERIMENT,
W70-09280
02G

WASS, BARVIM L. COASTAL BETLANDS OF VIRGINIA-INTERIS REPORT, W70-09350 02L

WATKINS, JOEL S.
THE USE OF SEISHIC REFRACTION AND GRAVITY METHODS IN HYDROGEOLOGICAL INVESTIGATIONS, W70-09399 07B

WAZIRUDDIE, S.
OPTIMIZATION OF WATER RESOURCES SYSTEMS BY THE GRADIENT PROJECTION AND THE CONJUGATE GRADIENT METHODS, W70-09092

Of A

WEEF, BICHAFL S.

HONTHLY MEAN SURPACE TEMPERATURES FOR LAKE ONTABIO AS DETERMINED BY ABRIAL SURVEY,

W70-09206

C2H

RETHAUG, CHARLES F.
NUMERICAL MODELING OF UNSATURATED GECUNDWATER FLOW AND
CUMPARISON OF THE MODEL TO A FIELD EXPERIMENT,
W70-09107
C2F

WESSELING, J.

AN INFILTRATION METHOD FOR THE DETERMINATION OF THE CAPILLARY COMDUCTIVITY OF UNDISTURBED SOIL CORES, W70-05261

07B

WHIPPLE, WILLIAM, JR.
BOD MASS BALANCE AND WATER QUALITY STANDARDS,

AUTHOR INDEX

.W70-09349 05A

HISIER, F. D. ANALYSIS OF INFILTRATION INTO STRATIFIED SOIL COLUMNS, \$70-09306 02G

HITESIDES, D. V.

COMMCN PEROFS IN DEVELOPING A GROUNDWATER AQUIFER,
W70-09225

OZF

HITTORD, WAITER G.

ERPSICLCCICAL RESPONSES TO TEMPERATURE AND DESICCATION IN
THE ENDEMIC NEW MEXICO PLETHODONTIDS, PLETHODON NECHEXICANUS
AND AMERICAS FARCIL,

#70-09145

O21

HEART RATE AND CHANGES IN BODY FLUIDS IN AESTIVATING TOADS FROM XEEIC HABITATS, #70-09148

WIFEF, K.
APPLICATION OF REGRESSION AWALYSIS IN HYDROLOGY,
W70-09391 07C

HIESNET, LONALD R.

ISOFACHOUS MAFFING OF THE LOWER PATDIENT ESTUARY SEDIMENTS
BY CONTINUOUS SEISMIC PROFILING TECHNIQUES,
870-03390 02L

WILLARDSON, L. S.

DRAIN INSTALLATION FOR NITRATE REDUCTION,
W70-09228

056

WILLIAMS, D. C., JE.
THE IMPOSTANCE OF WATER RELATED ACTIVITIES AT STATE PARKS IN
HISSISSIPPI,
#70-09259
06B

WITLIAMS, OWEN G.
BESERVOIR EFFECT ON DOWNSTREAD WATER TEMPERATURES IN THE UFFER DELIAWARE FIVER BASIN,
05A

WIISCN, F. F.
ANMONIA TOXICITY IN SELECTED PISHES,
W70-09430 05C

WIND, G. F. CAPILIARY CONDUCTIVITY DATA ESTIMATED BY A SIMPLE METROD, W70-09277 07B

WITHERSECON, FAUL A.
FINITE ELEMENT METHOD OF ANALYZING STEADY SEEPAGE WITH A
FREE SUBFACE,
W70-09198
0.2G

WITZEI, S. A.
A STUDY OF FARM WASTE, FARM ABHHAL WASTE CHARACTERIZATION,
BANDIING, UTILIZATION,
W70-09426

RIT, R. E.
AN INFILIRATION METHOD FOR THE DETERMINATION OF THE
CAPILLARY CONCUCTIVITY OF UNDISTURBED SOIL CORES,
W70-09281
07E

RLADITCHERSKY, S. A.
MOISTURE CONTENT AND HIDROPHILITY AS RELATED TO THE WATER
CAPILLARY BISE IN SCIIS,
02G
02G

WCCIF, L. A.

EQUIVALENCE OF ANOMALOUS WATER AND SILICIC ACID SOLUTIONS,

WOZAE, LAVID
HYDROLOGICAL ANALYSIS OF VOLCANIC TERRANE
THE FIO GRANDE DE SAN MIGUEL, EL SALVADOR,
W70-09370
03B

WRIGHT, THOMAS D.
COASTAL WETLANDS OF VIRGINIA-INTERIB REPORT,
W70-09350 02L

NU, SHARON S.
A STUTY OF HEAT TRANSFER COEFFICIENTS IN THE LOWEST 400 METERS OF THE ATMOSPHERE, #70-09156 02B

YAKOVLEVA, L. V.

CHARACTERISTICS OF SILTING OF SHALL FESERVOIRS OF THE
CENTRAL CHEMOZEM PROVINCES AND COMPUTATION OF DENSITY OF
BOTTCH DEFOSITS,
W70-09417

YANO, KATSUMASA
TRACER STUDIES ON THE MOVEMENT OF SAND AND GRAVEL, W70-09024
02J

THE EFFECT OF BED-LOAD EOVEMENT ON THE VELOCITY DISTRIBUTION OF FICH, W70-09052

YANG, T.

ALGAL CANCER AND CAUSAL SUBSTANCES IN WASTES FECH THE COAL CHEMICAL INDUSTRY,
W70-09437

YOUNG, GAIE
DRY LANDS AND DESALTED WATER,
970-09030 03C

YOUNG, J. D.
ON GEOLOGICAL AND TECHNOLOGICAL ASPECTS OF ORIENTED R-SIZE CORE DIAMOND DRILLING,
W70-05028
08E

YUNGKI, Y.
IMPULSE DISCHARGE ON CONTAMINATED SUBFACE,
W70-09039 08C

ZAVARINA, H. V.
METHODS OF COMPUTING MAXIMUM SOIL FEEFZING DEPTE,
W70-09104
02C

ZEIROBCWSKI-KOSCIA, K. F.
FOUNDATION SETTLEMENT AND GROUND REACTION CALCULATIONS USING
A DIGITAL COMPUTER,
W70-09036 08D

ZEMAITIS, WILLIAM L.

THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYCEN
CONCENTRATION IN THE DELAWARE RIVER,
W70-09189

05C

ZERZ, CAVID R.

EFFECTIVE PROSPHORUS REMOVAL BY THE ACDITION OF AIRM TO THE ACTIVATED SLUDGE PROCESS,

W70-09186 05D

ZINN, R. V.
DETAILING BY COMPUTER,
W70-09035



ORGANIZATIONAL INDEX

CALENIA F. P. R., EUCHAREST.
VALIDITY CONDITIONS OF THE POINT DILUTION METHOD,
R70-09284 02F GRICOLTUBAL RESEARCH SERVICE, AMES, IOWA AND IOWA STATE NIVERSITY, AVES.
INFLUENCE OF RAINFALL ENERGY ON SOIL LOSS AND INFILITRATION FATES 2. EFFECT OF CLOC SIZE DISTRIBUTION, W70-09378 AGRICULTURAL BESFARCH SERVICE, BRAWLEY, CALIF. SCUTHWESTERN IRRIGATION FIELD STATION SOIL CONSERVATION SERVICE, FRESNO, CALIF. AND BUSEAU OF RECLAMATION, SACRAMENTO, CALIF. LAND RESCURCES ERANCH.

IRAIN INSTALLATION FOR NITRATE REDUCTION,
W70-09228 05G AGRICULTURAL FESTARCH SERVICE, EURLINGTON, VT. SOIL AND WATER CONSERVATION FESTARCH DIV.
FREEZING AND THAWING EFFECTS ON DRAINAGE,
W70-09380 02G AGRICULTURAL BESEARCH SERVICE, CXFORD, MISS. SEDIMENTATION LAE. FLUME STUDIES OF THE SEDIMENT TRANSFER COEFFICIENT, 02JAGRICULTURAL SESEARCH SERVICE, FROENIX, ARIZ. WATER CONSERVATION THE LESIGN OF FLOATING COVERS FOR EVAFCHATION SECUCION, W70-09112 THE THREE-PRASE COMMIN IN HYDROLOGY, W70-09260 02F AGRICULTURAL BESTARCH SERVICE, RIVERSIDE, CALIF. SALINITY LAE.

BEASUREMENT OF WATER POTENTIAL AND CSMOTIC POTENTIALS IN SOIL WITH A COMBINED THERMOCOUPLE PSYCHROMETER AND SALINITY SENSOF, \$70-05364 AGEICULTUBAL RESEARCE SERVICE, STILLWATER, OKLA. SOIL AND WATER CONSERVATION RESEARCE DIV.
CALIERATION OF WALNUT GUICH SUPERCRITICAL FLUMES,
670-09218 AGRICULTURAL FESTARCH SERVICE, STILLWATER, OKIA. AND CKIAHCMA STATE UNIV., STILLWATER. DEET. OF AGRONOMY. EVALUATION OF SCIL MOISTURE MEASUREMENTS IN OKLAHOMA AS SOIL CHARACTERISTICS FOR CLASSIFICATION, AGRICULTURAL BESEARCH SERVICE, TUCSON, ARIZ. SOUTHWEST WATERSBED RESEARCH CENTER.
ESTIMATING STCERAGE CAPACITY IN DEEP ALLUVIUM BY GRAVITYSEISHIC METECLS,
670-09373 AGRICULTURAL SESTARCH SERVICE, URBANA, ILL. AND ILLINOIS UNIV., URBANA. AGRICULTURAL EXPERIMENT STATION. ANALYSIS OF INFILTRATION INIC STRATIFIED SOIL COLUMNS, W70-09306 02G AGRICULTURAL UNIV., WAGENIEGEN (NETHERLANDS). LAB. OF MICROBICLGY.
BESPONSE OF DAIRY WASTE ACTIVATED SLUDGE TO EXPERIMENTAL CONDITIONS AFFECTING PH AND FISSOLVED OXYGEN CONCENTRATION, 676-09332 ALE FORCE ENVIRONMENTAL TECHNICAL APPLICATIONS CENTER.
A SELECTED ANNOTATED ELELIOGRAPHY OF ENVIRONMENTAL STUDIES
OF FOLIAND,
R70-09456 AKALEMIYA NAUK UZBEKSKOI SSR, TASHKENT. INSTITUT MATERATIKI.

COMPUTATION OF THE DEFORMATION OF BARS AND NAVIGATION
CHANNELS,
W70-09256

02J ATASKA UNIV., COLLEGE. INST. OF MARINE SCIENCE.
CHEMICAL CHARACTERISTICS OF WATER MASSES IN THE AMEGASIAN
EASIN OF THE ARCTIC OCEAN,
W70-09230 02K ALI-UNION SCIENTIFIC AND RESEARCH INSTITUTE OF HYDROTECHNICS AND RECLARATION (USSE). NEUTRON MOISTURE METER FOR SALINE SOILS, N70-09268 ALI-UNION SCIENTIFIC AND RESEARCH INST. OF HYDROTECHNICS AND BECLAHATION (USSR).

SCHE NUMERICAL METHODS FOR SOLVING PROBLEMS OF NON-STEADY SEFFACE IN NON-HOMOGENEOUS ANISOTROFIC SOILS, W70-09309 EMBRICAN SOCIETY OF CIVIL ENGINEERS. COMMITTEE ON TIDAL HYLRADLICS OF THE HYDRAULICS DIV.
RESEARCH NEEDS ON THERMAL AND SEDIMENTARY POLLUTION IN TIDAL

AMERICAN WATER RESOURCES ASSOCIATION, URBANA, ILL-EVALUATION FROCESSES IN WATER RESOURCES PLANNING. 870-09369 06B AFIZONA STATE UNIV., TEMPE. COLL. OF ENGINEERING SCIENCES.
THE SEASONAL PERFORMANCE AND THE PATTERNS OF CHEMICAL AND
BIOLOGICAL EVENTS IN SEWAGE LAGOONS,
W70-09333 THERMAL ENERGY CONSERVATION AND SEQUENTIAL BIOLOGICAL PROCESSING APPLIED TO SEWAGE LAGOON DESIGN, W70-09334 ARIZONA UNIV., TUCSON.
TRANSPIRATION OF PONDEROSA PINE AND COUGLAS FIR AFTER
TREATMENT WITH PHENYLMERCURIC ACETATE,
W70-09207
03B ARIZONA UNIV., TUCSON. DEPT. OF BIOLOGICAL SCIENCES. WATER FCONOMY OF THE GREEN-TAILED TOWHEE (CHLORURA ARKANSAS UNIV., FAYETTEVILLE. WATER RESOURCES RESEARCH NIER. ENVIRONMENTAL CHANGES PRODUCED BY COLD-WATER OUTLETS FROM THREE ALKANSAS RESERVOIRS, ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISSACOUSTIC SUBBOTTOM PROFILING SYSTEMS, A STATE-OF-THE-ART SURVEY, W70-09176 OPERATING FORCES ON SECTOR GATES UNDER REVERSE BRAIS HYDRAULIC MODEL INVESTIGATION, 08B WAVE ACTION AND BREAKWATER LOCATION, VERMILION HAREOR, OHIO HYDRAULIC MODEL INVESTIGATION, W70-09178 ESTUARY ENTRANCE, UMPQUA RIVER, OBEGON HYDRAULIC MODEL INVESTIGATION, W70-05179 SPILLWAY AND OUTLET WORKS, ROWLESBURG DAM, CHEAT BIVER, WEST VIEGINIA HYDRAULIC MODEL INVESTIGATION, W70-09180 08B ARMY TERRESTRIAL SCIENCES CENTER, BANOVER, N.H. AN ANALYSIS OF ICE LENS FORMATION, W70-09114 02C ATLAS CHEMICAL INDUSTRIES, INC., WILMINGTON, DEL.
TREATMENT AND SLUDGE DISPOSAL OF WASTES FROM THE MANUFACTURE
OF ACTIVATED CARBON,
W70-09339
05D AUSTRALIAR NATIONAL UNIV., CANBERRA. RESEARCH SCHOOL OF PHYSICAL SCIENCES. EQUIVALENCE OF ANOMALOUS SATER AND SILICIC ACID SCIUTIONS, EATTFLIE MEMORIAL INST., COLUMBUS, OHIC, AND GEORGE WASHINGTON, D.C. NATURAL RESOURCES POLICY CENTER CENTER.
TIME BIAS IN RECREATION BENEFIT ESTIMATES, w70-09110 BATTELLE MEMORIAL INST., COLUMBUS, OBIO.
MANUAL ON SOLAR DISTILLATION OF SALINE WATER,
W70-09244 03A BATTELLE MEMORIAL INST., RICHLAND, WASE. TEMPERATURE, REPRODUCTION AND BEHAVICE, W70-09170 05C BATTELLE MEMORIAL INST., RICHLAND, WASH. EARTH SCIENCES P-N JUNCTIONS--A TOOL FOR TEMFERATURE MEASUREMENT, W70-09212 BAYERISCHE LANDESANSTALT PUR BODENKULTUE, PFLANZENBAU UND PFLANZENSCHUTZ, MUNICH (WEST GERMANY).

THE MOVEMENT OF WAITER IN SANDY SOILS AFTER PLOUGHING AT A DEPTH OF 50 CENTIMETERS, W70-09303 BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING. AQUIFE SIMULATION ON SLOW TIME RESISTANCE-CAPACITANCE NETWORKS, W70-09226 02F BONNEVILLE POWER ADMINISTRATION, PORTLAND, OREG.
CATHOLIC PROTECTION OF THE BONNEVILLE POWER ADMINISTRATION'S
34.5 KV SAN JUAN ISLANDS CABLE,
W70-09013
08C INSUIATION LEVELS OF DC FILTER REACTORS AND RESISTORS FOR HYDC POWER TRANSMISSION, 00C TRANSIENT OVERVOLTAGE ON A BIPOLAR BVDC OVERHEAD LINE CAUSED BY DC LINE PAULTS, 970-69018 BUENCS AIRES UNIV., (ARGENTINA). DEPT. OF AGRICULTURAL CLIMATOLOGY AND FEMOLOGY, AND AGROCLIMATOLOGY PROGRAMME OF THE CENTRO DE INVESTIGACIONES AGRICOLAS ALERTO BORRER, L

ESTANZUELA (UFUGUAY).
EYEGOLOGICAL CONSTANTS OF PARFEAN SOILS BROWN PRAIRIE AND FLACK FRAIRIE, 870-05287

EUEFAU OF CEOLOGIC AND MINE RESEARCH (PRANCE) AND GECTERFEX CC. (FRANCE).

ELECTROMOGNETIC ARRIAL SURVEY OF A FRESH WATER-SALT WATER CONTACT IN THE RHONE DELTA (FRENCH),
07B

BUREAU OF PUBLIC ROADS, WASHINGTON, D.C., FLECTRORIC COMPUTES FROGRAM FOR HYLRAULIC AMALYSIS OF BOX CULVERTS (BER FROGRAM HY-3), W70-09445

EUFFAU OF RECIAMATION, DENVER, CCLO.
CCMTROL AND REPAIR OF CRACKS IN CONCRETE DAMS,
W70-09019 08F

CCHSEBVATION OF CRAFT SKILLS IN DESIGN, 08F

EUERAU OF BECLARATION, LOS EANOS, CALIF. AND BUREAU OF BECLAHATION, TENVER, COLO.
FAPID BEVERSAL OF SAN LUIS FUBEING-GENERATING UNITS, W70-09024

BUBEAU OF SEVAGE IFFATHENT OPERATION FRIBRAM (CZECHOSICVAKIA).
FIUCTUATION OF EFFLUENT QUALITY IN ACTIVATED SLUDGE PLANTS, 87C-055C4 05D

EUBEAU OF SPORT FISHERIES AND WILDLIFF, LA CROSSE, WIS. FISE CONTEOL LAP. EFFECTS OF DIQUAT ON BLUEGILIS AND THEIR FOOT ORGANISMS, W70-08481

CALIFORNIA FUELIC UTILITIES COMMISSION.
ELECTRIC FOWER - IMFACT ON THE ENVIRONMENT,
W7C-05020 06B

CALIFORNIA STATE WATER RESOURCES CONTECL BOARD, SACRAMENTO.
WATER QUALITY FLANNING AND MANAGEMENT (PLANNING ESSENTIAL TO
INSUSE WATER QUALITY),
ETC-09056 05G

CALIFCENIA UNIV., EERKELEY.
FINITE ELEMENT HETHOD OF ANALYZING STEADY SEEPAGE WITH A
FREE SUFFACE,
BIO-09198

026

CALIFORNIA UNIV., DAVIS.
BESEARCH ON WATER QUALITY,
W70-09348

09A

CALIFORNIA UNIV., DAVIS. DEPT. OF SCILS AND PLANT NUTEFILOW. MINEFAL METABOLISM OF HAICPHYTES, 570-09147 021

CALIFORNIA UNIV., DAVIS. DEPT. OF WATER SCIENCE AND ENCINFERING CKIAHOMA STATE UNIV., STILLWATER ABIZONA UNIV., TUCSON AND NOFTH DENOTA STATE UNIV., FARGO. SCIL MATER LIFEUSIVITY AND WATER CONTENT DISTRIBUTION DURING COTFICE EXPERIMENT,

CALIFORNIA UNIV., DAVIS. REARNEY FOUNDATION OF SOIL SCIENCE AND CALIFORNIA UNIV., DAVIS. DEPT. OF SOILS AND FIANT MOISITION.
AGE OF QUATERNARY SEDIMENTS AND SOILS IN THE SACRAHENTO AREA, CALIFORNIA BY URANIUM AND ACTINIUM SERIES DATING OF VERTERPATE FOSSILS, 870-09239

CALIFORNIA UNIV., RIVERSIDE. DEPT: OF LIFE SCIENCES.
THE TERESTEIAL ECOLOGY OF THE SPADEFOOT TOAD SCAPHTOPUS HAMBONDII,
B70-09146 02G

CALIFICANIA UNIV., SANTA BARBARA.
TWO-DIMENSICHAL DISPERSION EXPERIMENTS IN A FORCUS MEDIUM, 870-09123 02F

CAMERICGE UNIV. (ENGLAND). DEPT. OF APPLIED MATHEMATICS AND THECHETICAL ENYSICS. EUGYANT FLUERS AND THERMALS, W70-09168

CABBING (W.) ABC CC. 11D. (GT. ERIT.).

1BE OFICIN AND CHARACTERISTICS OF TOXIC WASTES, WITH
FARTICULAR SEFERENCE TO THE METAL INDUSTRIES,
W70-09340

OSD.

CAFITCL CONTECLS CO., INC., COLHAR, FA.
ADVANCES IN HANDLING GAS CHICEINE,
870-09319

CATALYTIC, INC., FHILADELPHIA, PA.
SUPFRVISION, CONSTRUCTION AND EVALUATION OF A SEA WATER
DESULFATING PROCESS PILOT PLANT,
W70-09354
03A

CERTRAL INST. POF AGRICULTURAL BESTABCH, BUCHAREST (RCHANIA). SCIL FHYSICS LAB.
INFILIRATION BATE AS RELATED TO HYDRAULIC CONDUCTIVITY, HCISTURE DEFICIT AND OTHER SOIL PROPERTIES, 870-09300

CENTRAL FUELIC HEALTH ENGINEERING RESEARCH INST., NAGPUR

(INDIA). HICROBIOLOGY OF A WASTE STABILIZATION POND, W70-09508

CENTRAL RESEARCH INST. OF ELECTRIC POWER INDUSTRY, TORYO (JAFAN).
CALCULATION OF RADIO MOISE LEVEL FOR THE DESIGN OF AC FORERS TRANSMISSION LINES, W70-09038

CHICAGO UNIV., ILL.
A HOLEI OF WATER QUALITY HAVAGEMENT UNDER UNCERTAINTY, W70-09109

CHRYSIEF CORP:, DETROIT, EICH.
FLEXIBILITY KEY TO DESIGN OF MACHINING PLANT'S TREATMENT
PACIFITIES,
05D

CLEMSON UNIV., S.C. WATER RESOURCES BESTARCH INST.
FEQUIFEMENTS AND COSTS OF ALTERNATIVE SYSTEMS FOR TREATING
PEACE CANNERY WASTES.
W70-09183
06C

COAST GOARD, BALTIMORE, MC. FIELD TESTING AND DEVELOPMENT CENTER. SEWAGE FLANT GRINDER PUMP, W70-09446 05D

COLLEGE OF ENGINEERING, MADRAS (INDIA).
A CRITICAL STUDY OF THE THEORIES CONCERNING UTLIFT IN
HYDRAULIC STRUCTURES ON PERVIOUS FOUNDATIONS,
F70-05044

COLCEARD SCHOOL OF MINES, GOLDEN.

APPLICATION OF RESISTIVITY BETRODS IN MINERAL AND GROUNWATER EXPLORATION PECGRAMS,

W70-09407 07B

COLORADO STATE UNIV., FORT COLLINS.
TUFBULENT DIFFUSION IN A STABLY STRATIFIED SHEAR LAYER, W70-09173

COMMONNEALTH AND INTERNATIONAL LIBRARY CF SCIENCE TECHNOLOGY, ENGINEERING AND LIBERAL STUDIES, OTTAWA (CHIARIC). THE FHYSICS OF GLACIERS, 870-09412

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL BESEARCH OFGUNIZATION, CAMBERRA (AUSTRALIA). DIV. OF LAND RESEARCH AND BECICHAL SURVEY.

A DUPMAL DISTRIBUTION FUNCTION FOR CALLY EVAFORATION,

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH
OGGANIZATION, CAMBERRA (AUSTRALIA).
HYSTERESIS IN TWO SANDS AND THE INDEPENDENT DOMAIN MODEL,
N70-09209
026

COMMONNEALTH SCIENTIFIC AND INDUSTRIAL FESEARCH ORGANIZATION, CAMBERRA (AUSTRALTA). DIV. OF PLANT INDUSTRY. DIRECT MEASUREMENT OF MOISTURE POTENTIAL A NEW TECHNIQUE, 470-05275

DIFFUSIVITY DETERMINATION BY A NEW CUTPLOW METHOD, #70-04278

A LINEARIZATION TECHNIQUE FOR THE STUDY OF INPILTRATION, M70-09307

ABSORPTION AND INPILTRATION IN TWO- AND THREE-DIMENSIONAL SYSTEMS, 02G 02G

COOPERATIVE STATE RESEARCH SERVICE, WASHINGTON, D.C. WATER QUALITY A CONCERN FOR AGRICULTURAL ENGINEERS, W70-09499 05G

COPENHAGEN UNIV. (DENHARK). E. C. OPSTED INST. AND ARMY TERRESTRIAL SCIENCES CENTER, BANOVER, N.H. CLIMATIC OSCILLATIONS 1200-2000 A De N70-09224

CORPS OF ENGINEERS, LOS ANGELES, CALIF.
FLOOD FLATM INFORMATION, SANTA CLABA BIVER, VENTURA COUNTY,
CALIFORNIA.
W70-05221
ODA

CORPS OF ENGINEERS, MOBILE, ALA.
FICOD FLAIN INFORMATION, METROPOLITAN ATLANTA GEORGIA, UTOY
CREEK, NORTH AND SOUTH UTCY CREEKS.
04A

CORPS OF ENGINEERS, PITTSBURGH, PA.
PLCOD FLATH INFORMATION, ALLEGHEWY RIVER AND FIVEHILE CREEK,
ALLEGANY, NEW YORK.
W70-05252

CORPS OF ENGINEERS, FORTLAND, OREG. MORTH PACIFIC CIV. BUNOFF SYNTHESIS FOR BAIN-ON-SHOW EASIN, W70+05027 02E

CORPS OF ENGINEERS, SAN FRANCISCO, CALIF.
FLOOD FLAIN INFORMATION, COTOTE CREEK, SAN FRANCISCO BAY TO
ANDESON RESERVOIR, SANTA CLARA COUNTY, CALIFORNIA.
N70-09365

CORPS OF ENGINEERS, TULSA, OKLA.
FLOOL FLAIM INFORMATION, COTTONWOOD CHEEK, GUTHRIE, OKLAHOMA.

04A

SES OF ENGINEERS, WALLA WALLA, WASH. CFEFATION AND MAINTENANCE OF LARGE HIDRO TURBINES - COLUMBIA AND SNAKE FIVEES, W70-05047 08C

DEFOSION AND WELDING ENGINEERING LTD. (GREAT ERITAIN).
INTERNAL CATHODIC PROTECTION OF WATER COOLED PLANT,
W70-09014 08C

DUNCIL ON ENVIRONMENTAL QUALITY, WASHINGTON, D.C. ENVIRONMENTAL QUALITY. W70-09347 05G

AMES AND MOOFE, SAN FRANCISCO, CALIF-PREDICTIONS OF FESEBYCIE LEARNEE, 870-05046

ELAWARE SIVES BASIN COMMISSION, TRENTON, N.J. BESERVOIR EFFECT ON DOWNSTREAM WATER TEMPERATURES IN THE UFFES CRIMARE SIVER PASIN, W70-09171 05A

EFABLIMENT OF AGRICULTURE, LETHERIDGE (ALBERTA). WATER
ESCUBLES DIV.
MIGRATICN OF SOLUBLE SALIS IN AN IRRIGATED FIELD IN RELATION
TO BAINFALL AND IRRIGATION,
W70-C9140
03C

DEFABLHENT OF AGRICULTURE, WASHINGTON, D.C. AND DEPARTMENT FOUSING AND DREAN DEVELOPMENT, WASHINGTON, D.C. SCIL, WATER AND SUPUREIA. 068

DEFARTHENT OF EMERGY, MINES AND RESOURCES, OTTAWA (ONTARIO).
INIAND WATERS EFANCE.
INTERGENTS, PROSPHATES, AND WATER POLLUTION,
W70-C9388

APPLICATION OF BEGRESSION ANALYSIS IN HYDROLOGY, 070-09391

DEFARTMENT OF NATIONAL HEALTH AND WELFARE, EDMONTON (ALBERTA). PUBLIC HEALTH ENGINEERING DIV.
EUROPEAN WASTE WATER HANAGEHENT AND BESEARCH,
W70-09322.

DEUTSCHE AKADEHIE DER LANDWIRTSCHAFTSWISSENCHAFTEN ZU BERLIN (ZAST GERBANY). A STUDY ON FRESSURE MEMBBANE PROPERTIES IN BELATION TO CAPILLARY CONDUCTIVITY MEASUREMENTS, #70-09279 02G

DREXEL UNIV., PHILADELPHIA, PA. DEPT. OF CIVIL ENGINEERING. THE EFFECT OF BIOLOGICAL LIFE ON THE DISSOLVED OXYGEN CONCENTRATION IN THE DELABASE BIVES,

DU PONT DE MEMOURS (E. I.) AND CO., AIKEN, S.C. A GARMA-EHOTOMEUTRON METHOD FOR LAFORATORY STUDIES OF SOIL MATER,

ECCLOGICAL SOCIETY OF AMERICA, DURHAM, N.C., AND PEAT, MARNICK, HITCHELL AND CC.
NATIONAL INSTITUTE OF ECOLOGY AM INQUIRY, VOLUMES 1 AND 2.
W7C-09366

EDISON ELECTRIC INST., N.Y.

EAJOR ELECTRIC FOWER FACILITIES AND THE ENVIRONMENT,

#70-09048

066

EMSCHERGERCSSENSCHAPT, ESSEN (WEST GERMANY).
ENERGY AND EYDRAULIC TESTS ON MECHANICAL ABRATION SYSTEMS,
05D

FELERAL FARTH RESPARCE INST., HAMOVER (REST GERMANY).
INTERFRETATION OF GECELECTRICAL RESISTIVITY MEASUREMENTS FOR
SCLIVING HYDROGECICGICAL FRCELESS,
W7G-09409
07B

FIRMISH HYDROLOGICAL CFFICE, EFISINKI.
THE LETERMINATION OF SOIL HOISTORE WITH THE NEUTRON SCATTERING METHOD IN FINLAND,
07E 470-05267

FISHERIES RESEARCH BOARD OF CANADA, ST. ANDREWS (NEW EFFORTS OF SUBLETHAL DDT ON A SIMPLE REFIEX IN BROCK TROUT, W70-09428

FICFICA STATE UNIV., TAILAHASSEE.

A HODIFICATION OF THE BENZENE SYNTHESIS METHOD FOR TRITIUM INAIVSIS,

\$70-09213

POCD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, KINGSTON (JAMAICA).

BYDROLOGICAL ANALYSIS OF VOLCANIC TERBANE LOWER BASING THE BIO GRANDE DE SAN HIGUEL, EL SALVADOR, 03E

FOREST RESEARCH INST., BUDDAPEST (HUNGARY).

MEASUREMENT OF SOIL HOISTURE FROM THE TEMPERATURE GRADIENT,

W70-09269

FCEEST SERVICE (USCA), FLAGSTAFF, ARIZ. ROCKY MOUNTAIN FCEEST AND FANGE EXPERIMENT STATION. A SYSTEM FOR HEASURING TOTAL SEDIMENT YIELD FROM SHALL HATTESHEDS,

¥70-09121

FOREST SERVICE (USDA), FORT COLLINS, COLO. ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION.

MORPHCLOGY OF GULLIES IN THE COLORADO ROCKY MOUNTAINS,

GENERAL ELECTRIC CO., PHILADELPHIA, PA. AND POWER TECHNOLOGIES, INC., SCHENECTADY, N.Y. PREDICTION OF RELIABILITY AND AVAILABILITY OF HYDC VALVE AND HYDC TERMINAL, W70-09017 08C

02J

GEOLOGICAL SURVEY OF CANALA, OTTAWA (CHIARIO). MINING AND GROUNDWATER GEOPHYSICS/1967. W70-09392 07B

SEISMIC METHODS IN MINING AND GROUNDWATER EXPLORATION, W70-09406

GEOLOGICAL SURVEY OF DENMARK, COPENHAGEN.
PUMPING TESTS AND HYDROGEOLOGICAL INVESTIGATIONS OF AN
ARTESIAN AQUIFER NEAR HORSENS, DENMARK,
W70-09237

GEOLOGICAL SURVEY, AUGUSTA, MAINE. A PROPOSED STREAMFLOW DATA PROGRAM POF MAINE, 870-09353 07A

GEOLOGICAL SURVEY, BISMARCK, N. DAK.
GROUNDWATER BASIC DATA, PART 2 OF GEOLOGY AND GROUNDWATER
RESOURCES OF MERCER AND OLIVER COUNTIES, NORTH DAKCTA,
1870-09367

GEOLOGICAL SURVEY, CHAMPAIGN, IIL.
FLOOT PLAIN MAPPING BY THE U. S. GEOLOGICAL SURVEY,
W70-09255 06F

GEOLOGICAL SURVEY, COLUMBIA, S.C.
GROUNDWATER RECORDS OF SOUTH CAROLINA - 1966, 970-09411

GEOLOGICAL SURVEY, DENVER, COLO.
PLANT COVER, RUNOFF, AND SEDIMENT YIELD RELATIONSHIES ON MANCGS SHALE IN WESTERN COLORADO,
W70-09118
02J

BOREHOLY GEOPHYSICS AS APPLIED TO GROUNDWATER,

THE ROLE OP GEOPHYSICS IN THE DEVELOPMENT OF THE WORLD'S GROUNDWATER RESOURCES, W70-09405

GEOLOGICAL SURVEY, DENVER, COLO. WATER RESOURCES DIV.
CALLERATION AND EVALUATION OF A WIDE BANGE METHOD FOR
MEASURING MOISTURE STRESS IN FIELD SCIL SAMPLES,

GEOLOGICAL SURVEY, IOWA CITY, IOWA. FLCODS IN IOWA, W70-09254 028

GEOLOGICAL SURVEY, JACKSON, MISS.
WATER-IEVEL AND WATER-QUALITY TRENDS IN AQUIFERS ALONG THE
MISSISSIPPI GULF COAST, 1970,

GEOLOGICAL SURVEY, LOUISVILLE, KY. WATER RESOURCES DIV. COMMON ERRORS IN DEVELOPING A GROUNDWATER AQUIFER, W70-09225 02F

GEOLOGICAL SURVEY, LUBBOCK, TEX. AND TEXAS TECH UNIV., UBBCCK.
WATER USE BY SALT CEDAR,
#70-09113

GEOLOGICAL SURVEY, MENLO PARK, CALIF.
SUMMARY OF GROUNDWATER OCCURRENCE IN CALIFORNIA,
W70-09214 02F

GEOLOGICAL SURVEY, RALEIGH, N.C. AND NORTH CAROLINA UNIV., RALEIGH.
THE USE OF SEISMIC REFRACTION AND GRAVITY HETHODS IN HYLROGEOLOGICAL INVESTIGATIONS,

GBOLGGICAL SURVEY, RICHMOND, VA. FLOOD OF AUGUST 1969 IN VIRGINIA, W70-09234

GEOLOGICAL SURVEY, WASHINGTON, D. C.
DIGITAL ANALYSIS OF AREAL PLOW IN MULTIAQUIFER GROUNDWATER
SYSTEMS A QUASI THREE-DIMENSIONAL MCDEL,
W70-09197 02F

GEOLOGICAL SURVEY, WASHINGTON, D.C. ELEMENTAL SULFUR IN EDDY COUNTY, NEW MEXICE, W70-09128

WATER AS AN URBAN RESOURCE AND MUISANCE, W70-09129 04C

RECORNAISSANCE OF WATER RESOURCES IN THE HAINTS-PORT CHILBOCT AREA, ALASKA, 170-09130

WATER LAWS AND CONCEPTS, W70-09131

HYDROLOGY OF THE UPPER MALAD RIVER BASIK, SOUTHEASTERN

IDARC, 870-09132 COMPOSITION OF WATER IN CLINCE RIVER, TENNESSEE RIVER, AND WHITFOAK CREEK AS RELATED TO DISPOSAL OF LOW LEVEL FADICACTIVE INCOLUMNSTES, A NUMERICAL TECHNIQUE FOR CALCULATING THE TRANSIENT POSITION OF THE SALTWATER FRONT, W70-09196 SCME EFFECTS OF FEESH-WATER INFLOW ON THE PLUSHING OF SOUTH SAN FRANCISCO EAY A FREITHINAFY FEFORT, \$170-09-15 05G W70-09215 MOVEMENT OF SEARED DRIFTERS IN THE SAN FRANCISCO BAY ESTUARY AND THE ADJACENT PACIFIC OCEAN A FRELIMINARY REPORT, 470-09216 A SUMMARY OF PEELIMINARY STUDIES OF SEDIMENTATION AND EYDROLOGY IS ECLINAS LAGCON, MARIN CCUMTY, CALIFORNIA, W70-09235 BECONNAISSANCE OF THE GROUNDWATER RESOURCES OF THE MISSOURI FIVER ALLUVIUM BETWEEN MIAMI AND KANSAS CITY, MISSOURI, #70-09249 02F WATER BUDGET OF UPPER KLANATH LAKE SOUTHWESTERN CREGON, 170-C9250 FOILUTION OF ESTUARIES. N70-09383 050 GECLOGICAL SUBVEY, WASHINGTON, D.C. WATER RESOURCES DIV. FEFCRT OF WATER RESOURCES RESEARCH, JULY 1, 1968 - JUNE 30, W70-09389 0.90 GECLOGICAL SUBVEY, WASHINGTON, D.C., AND NATIONAL PARK SERVICE, WASHINGTON, D.C. HYDROCARBONS IN THEEMAL AREAS, NORTHWESTERN WYOMING, GECNAUTICS, INC., WASHINGTON, D.C.

THE USE OF GRAVIMETER MEASUREMENTS IN MINING AND GROUNDWATER
EXFLORATION, 97B GEORGIA INST. OF TECH., ATLANTA. ENGINEERING EXPERIMENT LICH. LIOTRACER STUDIES ON RAPID SAND FILTRATION, GEORGIA UNIV., ATHENS.

FFFECTS CF FOREST CLEAR-FELLING ON THE STORM HYDROGRAPH, W70-09117

03B TO UNIV. (JAPAN). FACULTY OF AGRICULTURE. A THEORETICAL ANALYSIS AND NUMERICAL SOLUTIONS OF UNSATURATED FLOW IN SOIL. GIASGOW DRIV. (SCCTLAND) AND DARTHOUTH COLL., HANOVER, N.H. A CONTRIBUTION TOWARDS THE REDUCTION OF ICE FOG CAUSED BY HUHIL STACK GASES AT ALASKAN FOWER STATIONS, W70-09172 OSG GUELPE UNIV. (ONTARIO). DEPT. CF SOIL SCIENCE.
THE MICROHYDROLOGICAL CHARACTERIZATION OF SOILS,
#70-09289 02G BELSIBKI EYDRCLOGICAL CFFICE (FINLAND).
CN THE ACRESION OF PORE WATER IN FINNISH ARGILLACEOUS SEDIMENTS OF DIFFERENT AGE,
870-09195 02G HUBBLZ CII AND REFINING CO., FAYTOWN, TRX.
IM-FIANT WASTE REDUCTION,
W70-09316
05 HODGARIAN UNIV. OF AGRICULTURAL SCIENCES, GODOLLO (HUNGARY).
INFILTRATION IN TERMS OF SOIL HOISTURE, RAIN INTENSITY AND
DEPTH OF FAINFALL,
W70-09301
02G HYDRAULIC RESEARCH INST., PRAGUE (CZECHOSLOVAKIA).

ZONE IRRGHAS OF AIR EMULSION IN WATER DOWNSTREAM OF THE RING
JUHF IN PIPES,
W7C-C9022 SCHE METHODS FOR THE DETERMINATION OF SOIL MOISTURE AND EALANCE MEASURING, 07P. HYDFONAUTICS INC., LAUREL, MD.
A COMPACTION THEORY FOR MCDIFIED REVERSE OSMOSIS MEMBRANES, 870-09358 HYDBONAUTICS, INC., LAUBEL, MC.
BYDBOCASTING FEVERSE OSMOSIS MEMERANES,
H70-05246 03A LESIGN AND CONSTRUCTION SYSTEM FOR THE DETERMINATION OF TRANSFORT AND COMPACTION COMPACTIONS OF REVERSE OSMOSIS MEMBERANES, W70-09356 THE CETERBIKATION OF THE TRANSPORT COEFFICIENTS OF CELLULOSE ACTIATE MEHIFFAMES, W70-0535

COMPACTION OF CELLULOSE ACETATE MEMERANES, IEM WATSON RESEARCH CENTER, TORKTOWN HEIGHTS, N.Y.
USE OF TOPOLOGIC INFORMATION IN PROCESSING DATA FOR CHANNER
NETHORKS,
W70-09204
07C IHARA AGRICULTURAL CHEMICALS INST., SHIMIZU (JAPAN).
AN ANALYTICAL METHOD FOR EVALUATING THE SUSCEPTIBILITY OF
FISH SPECIES TO AN AGRICULTURAL CHEMICAL (JAPANESE),
W70-09423
054 #70-09433 ILLINOIS STATE GEOLOGICAL SURVEY, URBANA.
GRCUNDWATER DISCHARGE IN THE ILLINOIS BASIN AS SUGGESTED BY
TEMPERATURE ANOMALIES, ILLINOIS UNIV., URBANA AND AGRICULTURAL RESEARCH SERVICE, UPBANA. HIDRAULIC AND PRESSURE HEAD MEASUREMENT WITH STRAIN GAUGE PRESSURE TRANSDUCERS, 970-09274 ILLINOIS UNIV., UEBANA AND METROPOLITAN SANITARY DISTRICT CF GFEATEE CHICAGO, ILL. DIGESTED SLUDGE DISPOSAL CW CROP LAND, W70-09328 FILINOIS UNIV., URBANA HASSACHUSETTS INST. OF TECH.
CAMBRIDGE AND CALIFORNIA UNIV., BERKELEY. DEPT. OF CIVIL
ENGINEERING.
DISPERSION IN HOMOGENEOUS ESTUARY FLOW,
W70-09217
02L ILLINOIS UNIV., URBANA.
STOCHASTIC HODELS IN HYDROLOGY,
W70-09115 06A TURBULENCE MEASUREMENTS NEAR THE PREE SURFACE OF AN OPEN THICKENING CHARACTERISTICS OF ACTIVATED SLUDGE, 970-09505 INSTITUT FUER PISCHERZI, BAMBURG (WEST GERMANY).

PRELIMINARY RESULTS OF THE EXPERIMENTS ON THE TOXICITY OF
OIL COUNTERACTING AGENT (ESSO COREXIT 7664), WITH AND
WITHOUT IRAQ CRUDE OIL, FOR SELECTED MEMBERS OF MARINE
PLANKTON,
W70-09434

OSC INSTITUT NATIONAL DE LA RECHERCHE AGRONOHIQUE, VERSAIILES (FRANCE). SOILS LAB.
REDISTRIBUTION OF MOISTURE AFTER INPILTRATION IN DBY SOILS.
INFLOENCE OF GRAVITY,
W70-09299 02G INSTITUT PRIKLADNOI GEOFIZIKI, LENINGRAD (USSE).
SOIL MCISTURE PRESSURE IN SOME CLIMATIC ZONES,
W70-09291 02G INSTITUTE FOR LAND AND WATER HANAGEMENT RESEARCH, WAGENINGEN (NETBERLANDS).
CAPILLARY CONDUCTIVITY DATA ESTINATED BY A SHPILE HETROD, W70-09277 AN INFILTRATION METHOD FOR THE DETERMINATION OF THE CAFILLARY CONDUCTIVITY OF UNDISTURBED SOIL CORES, W70-09281 THE RELATION BETWEEN LITHOLOGICAL PROFERTIES AND THE SHAPE OF THE DESCRIPTION CURVE, W70-09268 AN EMPIRICAL EXPRESSION FOR THE DESCRIPTION CURVE, W70-09292 02G DETERMINATION OF PORE SIZE BY THE AIR BUBBLING PRESSURE METHOD, W70-09297 THE RELATION BETWEEN PARTICLE SIZE, PORE SIZE AND EYDRAULIC CONDUCTIVITY OF SAND SEPARATES, 02G INSTITUTE OF AGRICULTURAL RESEARCH, ADDIS ABABA (ETHIOPIA). PADDI RATOONS, W70-09501 03F INSTITUTE OF ARCTIC BIOLOGY, ALASKA UNIVERSITY, COLLEGE, ASKA. TEMPEBATURE-DEPENDENT CHARACTERISTICS OF PERIPHPRAT NERVES EXPOSED TO DIFFERENT THERMAL CONDITIONS IN THE SAME ANIMAL, W70-09160 INSTITUTE OF GEOLOGICAL SCIENCES, LONDON (ENGLAND).
APPLIED GEOPHYSICS IN THE NATURAL ENVIRONMENT RESEARCH
COUNCIL IN GREAT BRITAIN,
W70-09398 INSTITUTE OF HYDROTECHNICAL RESEARCH, BUCHAREST (ROMANIA).
INFRARED SPECTROPHOTOMETRIC STUDY OF RET CLAY SOILS (PRENCH), W70-09293 INSTITUTE OF HYDROTECHNICAL BESEARCH, BUCHARIST (RUMANIA).

DETERMINATION OF THE COEFFICIENTS OF WATER HIGRATICS THROUGH ¥70-09283

STITUTE OF IECHNOLOGY, STOCKHOLM(SWEDEN).
CHANGES IN THE NOISTURE CONTENT OF THE TOPSOIL AS MEASURED WITH A NEUTEON MOISTURE GAUGE,
W70-C526 02G

ISTITUUT VOOR GEZCNDHEIDSTECHNIEK TNO, DEIFT (NETHERLANDS), INVESTIGATION ON THE CONTROL OF FILAMENTOUS EULKING, 670-09509 05D

NTERNATIONAL ATCHIC ENERGY AGENCY, VIENNA (AUSTRIA). DIV. F ESSFARCE AND LABORATORIES. NUCLEAR TECHNIQUES IN HYDROLOGICAL INVESTIGATIONS IN THE UNSATURATED ZONE,

ORA STATE UNIV., AMES.
SOLITEMETRATURE AND WATER CONTENT CHANGES DURING DRYING AS
INFLUENCED BY CRACKS A LARGEATORY EXPERIMENT,
W70-09379
02G

ONA STATE UNIV., AMES. DEFT. OF CIVIL ENGINEERING. FLOOD STAIN MANAGEMENT - IOWA'S EXPERIENCE. #70-09253 06F

CNA UNIV., ICWA CITY.
AN ELECTRO-OPTICAL PROBE FOR HEASUREMENT OF SUSPENDED
SEDIMENT CONCENTRATION,
870-05026
02J

CERS HOPKINS UNIV., PAITIMORE, MD. DEPT OF SANITARY NOTINETEING AND WATER RESOURCES.
AN EVALUATION OF THE ERCBLEMS OF SANITARY SEWER SYSTEM IESICM, W70-09165

CNES AND LAUGHLIN STEEL CCRP., PITTSBURGH, PA. FOLLER FLUS MAGNETIC FIELD USED TO TREAT PARAMAGNETIC

DEBIAN (BEWARE C.), INC., PORTLAND, MAINE AND MAINE UNIV.

CATTLE SKIN TANNERY WASTES TREATMENT IN A COMPLETELY MIXED ACTIVATE SIDDEE PILOT PLANT,

MAISER ENGINEERS, CAKLAND, CALIF. ENGINEERING AND ECONOMIC EVALUATION STUDY OF REVERSE CSMCSIS, . W70-09363

KANSAS STATE UNIV., MANHATTAN. DEPT. OF INDUSTRIAL RECINETING.

CFTIMIZATION OF WATER RESOURCES SYSTEMS BY THE GRADIENT FEOJECTION AND THE CONJUGATE GRADIENT METHODS,

OGA

RAKSAS UNIV., LAWRENCE, AND GECLOGICAL SURVEY, GARDEN CITY,

NAMES OF THE MODEL TO A FIELD EXPERIMENT, E70-09107

MARISAUHE UNIV. (WIST CERMANY). HOSPHORUS REMOVAL WITH FERRIC IRON AND ALUMINUM, W7C-09507

RENNECOTT EXFICEATION DEL ECUADOR, QUITO AND PROYECTO SINEEO, QUITO (ECUATOR).

A GEOCHEFICAL DEALNAGE SURVEY IN CENTRAL ECUADOR,

KENTUCKY DEFT. OF HIGHWAYS, LEXINGTON. DIV. OF RESEARCH.

FHECICGICAL AND ULTIPATE STRENGTH FROPERTIES OF COERSIVE
SCIIS,
W70-CS452
08D

REARTCUM UNIV. (SUDAN).
ANALYSIS OF SOME PACTORS AFFECTING THE WATER VAPOUR
DIFFUSION IN SOILS,

RIFL UNIV. (WEST GERMANY).

EPFECT OF TEMPERATURE SHOCK ON THE TEMPERATURE RESISTANCE OF
FOIRTLCHEBE ACCURTE ANIMALS. EXPERIMENTS ON THE PROBLEM OF
FEAT ANI COLD-BARDENING IN ANIMALS (GERMAN),
870-09436

RYCTO UNIV, (JAPAN) AND CSAKA PREFECTURAL TECHNICAL COLL., BEYNGAWA (JAFAN).

THE EFFECT OF BED-LOAD MOVEMENT ON THE VELOCITY DISTRIBUTION OF FICH, W70-09052

KYCIO UNIV. (JAFAN).
TRACER STUDIES ON THE HOVEMENT OF SAND AND GRAVEL, H70-09024

NYTISHU UNIV., FURUCKA (JAFAN). DEFT. OF FISHERIES
CHEHISTRY.
AIGAL CANCEE AND CAUSAL SUBSTANCES IN WASTES FROM THE COAL
CHEHICAL INTUSTRY,
W70-09437

LAPCBATCRIFS OF FLUID MECHANICS, GRENOBLE (PRANCE).
VERIFICATION OF THE GENERALIZED DARCY'S LAW AND
DETERMINATION OF CAPILLARY CONDUCTIVITY AT THE BEGINNING OF
ECHIZOBAL INFILTRATION (FRENCH),
026

LENINGRAD STATE UNIV. (USSE). LIMNOLOGY LAB.
SMALL BESERVOIRS AND PONDS OF THE CENTRAL CHERNOZEM
FRCVINCES, RSFSR,

DEVELOPING A METHOD OF COMPUTING SILTING OF SMALL FESERVOIRS IN THE CENTRAL CHERNOZEM PROVINCES, W70-09418 02J

LOS ANGELES COUNTY SANITATION DISTRICT, CALIF.

ODCR CONTROL METHODS, EXPERIMENTATION AND APPLICATION,
W70-09190 OSD

LOUISIANA WILD LIFE AND FISHERIES COMMISSION.
TOXICITY OF SELECTED HERBICIDES TO BLUEGILI SUNFISH.
W70-05435

MAHARAJA SAYAJIRAO UNIV. OF BARODA (INCIA).
FINGER IMBIBITION IN ARTIFICIAL REPLENISHMENT OF GROUNDWATER THROUGH CRACKED POROUS HEDIUM,
W70-09200 02F

MAIN GEOPHYSICAL OBSERVATORY, LENINGRAD (USSR). REASONS FOR CLIMATIC CHANGES IN THE GEOLOGICAL PAST,

CHEMICAL COMPOSITION OF PRECIPITATION IN REGIONS OF THE SOVIET UNION, W70-09133

MARATHWADA JNIV., AURANGABAD (INDIA). DEPT. OF ZOOLOGY.

EFFECT OF TEMPERATURE AND SALINITY ON THE HEAT TOLERANCE IN
THE HERMIT CRAB, DIOGENIS BICRISTIMANUS,

#70-09166 05C

MARYLAND CEPT. OF STATE PLANNING, BALTIMORE. SCENIC RIVERS IN MARYLAND. W70-09448 066

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. CENTER FOR SPACE RESEARCE.
UNIVERSITY ROLE IN ASTRONAUT LIFE SUFPORT SYSTEMS WATER

RECCVERY SYSTEMS, W70-09236

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF TECHNOLOGY.

WATER WAPOR BALANCE OF THE ATMOSPHERE PROB PIVE YEARS OF HEBISFHERIC DATA,

028

METROROLOGICAL SERVICE OF CANADA, CALGARY (ALBERTA).
AN ENERGY BUGGET STUDY ABOVE THE POREST CANOPY AT MARMOT CREEK, ALERTA, 1967,
H70-09111

METEGROLOGICAL SERVICE OF CANADA, TOROSTO (ORTABIO).

MONTELY MEAN SURFACE TEMPERATURES FOR LAKE CHTARIC AS
DETERMINED BY AZRIAL SURVEY.

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO, III.

EFFECTIVE PHOSPHORUS REMOVAL BY THE ALDITION OF ALUB TO THE
ACTIVATED SLUDGE PROCESS,

ICHIGAN STATE UNIV., EAST LANSING. DEFT. OF AGRICULTURAL RICHIGAN STATE ON THE PROJECT EVALUATION PROCEDURES WITH EMPHASIS ON REGIONAL INCOMP AND ENVIRONMENTAL QUALITY DETRCIT RIVER, TRENTON NAVIGATION CHANNEL, W70-09497

MIDDLE EASTERN REGIONAL RADIOISOTOPE CERTER FOR THE AFAB
COUNTRIES, CAIRO (EGYPT) DETERMINATION OF THE VELOCITY AND DIRECTION OF GROUNDWATER
FLOW BY RADIOISOTOPES,
W70-09386

MINISTERSTVO GEOLOGII, MOSCON (USSR).
GEOPHYSICS IN PROSPECTING AND EXPLORATION FOR MINERAL
DEFOSITS IN THE U.S.S.R.,
W70-09393

MINISTRY OF WORKS, WELLINGTON (NEW ZEALAND). WATER AND SOIL PREPARATORY REPORT OF THE TECHNICAL SUBCOMMITTEE OR SHOW.

MINNESCIA UNIV., MINNEAFOLIS. A STATEMENT ON PHOSPHORUS, W70-09325

MISSISSIPPI STATE UMIV., STATE COLLEGE. WATER RESOURCES

RESFARCE INST.
A STODY OF THE HYDROCHEMICAL PACIES OF THE WILCOX AQUIPERS
IN MISSISSIPPI,

THE IMPORTANCE OF WATER RELATED ACTIVITIES AT STATE PARKS IN MISSISSIPEL. W70-09259

THE EFFECT OF TEMPERATURE ON WATER FICE IN SOILS, 02G.

A STUDI OF THE AQUATIC ECOSYSTEMS IN TWO NATIONAL WATERFOWL RFFUGES IN MISSISSIPPI, Q2I

MIS-NCF SYSTEM APPROACH FOR THE STUDY AND CONTROL OF FACTORS AFFECTING WATER FCILUTION, W70-09422 FCRAGE CHOP IBEIGATION WITH OXIDATION FOND EFFLUENT, THE EFFECT OF SALINITY ON THE OXIDATION OF HYDROCARBONS IN ESTUARINE ENVIRONMENTS, W70-09424 HISSCORI UNIV., COLUMEIA. DEPT. OF AGRICULTURAL CHEMISTRY.
ABBCNIA TOXICITY IN SELECTED FISHES,
W70-09430 05C MONTANA STATE UNIV., BOZEMAN. DEP ESCENEWATER VELCCITY FASTITICS, W70-09227 DEPT. OF EARTH SCIENCES. HOSCOW STATE UNIV. (USSR), GEOGRAFISCAL FROSPECTING FOR GROUNDWATER IN THE SOVIET UNION, #70-09461 07B HOSCOW STATE UNIV. (USSR). DEPI. OF GEOPHYSICS. GEOPHYSICAL SIDDIES IN FERNAFRCST REGIONS IN THE U.S.S.R., W70-09396 MUESER, RUTIELGE, WENTFORTH AND JOHNSTON, NEW YORK.

IATERAL FRESSURES ON EIGID PERBANENT STRUCTURES,

W70-09045

08D NAGASAKI UNIV. (JAPAN) KAGOSHIMA UNIV. (JAPAN) AND RYUSHU INSI. CF TECH. (JAPAN). IMPULSE DISCHARGE ON CONTAMINATED SURPACE, E7C-09039 08C NACOTA UNIV. (JAPAN) TOTOTA COIL. OF TECHNOLOGY (JAPAN) ANT MITSUI SHIP BUILDING CO., OKAVAHA (JAPAN). FIOW CF ENTFAINED AIF IN CENTFIFUGAL PUMFS, W70-09023 NATIONAL ACADEMY OF SCIENCES-NATIONAL ACADEMY OF ENGINEERING, WASHINGTON, D.C. ENVIRONMENTAL STUDIES BOARD. CEAFTER 1 INTRODUCTION. W70-09439 06E CHAPTER 2 W70-09440 INSTITUTE FOF ANALYTICAL STUDIES. EDUCATION AND THE ENVIRONMENT. MONITORING THE ENVIRONMENT. 07B **CEAFTER 4 W70-09442** CHAPTER 5 870-09443 NATIONAL LABORATORY FOR ENVIRONMENTAL SCIENCE. CHAPTER 6 FEDERAL CEGANIZATION FCB MANAGING THE PROPOSED FOR THE PROPOSED NATIONAL AND UNIV. INST. OF AGRICULTUBE, REBOVOTH (ISBAEL). VCICANI INST. OF AGRICULTUBE RESEARCH.
FACTORS AFFECTING SEED GERMINATION UNDER SOIL MOISTURE THE EFFECT OF SOIL MOISTURE LEVEL OF THE INCIDENCE OF EARLY EXTONOOGIST AND TOWARD FLANTS, 870-09137 BATICHAL AND UBIV. INST. OF AGRICULTURE, REHOVOTH (ISRAEL). VCLCAMT INST. OF AGRICULTURE RESEARCH AND HEBREW UNIV., JEBUSALM (ISRAEL). EXPL. OF ECTAMY. EFFECT OF VARIATIONS IN SUBSTRATE SALINITY ON THE WATER PALANCE AND IONIC COMPOSITION OF BEAM LEAVES, 670-09144 NATIONAL EBVIBONMENTAL SATELLITE CENTER, WASHINGTON, C.C. STUDY OF THE USE OF AEBIBL AND SATELLITE PHOTOGRAPHETRY FOR SURVEYS IN EVENDOLOGY, 670-09454 BATIGNAL SCIENCE FOUNDATION, WASHINGTON, D.C. SPECIAL FICHIGH CURRENCY SCIENCE IMPORBATION PROGRAM.

COMPLEX EQUIPMENT FOR SINKING AND DRILLING OF VERTICAL SEAFTS, 670-09447

W70-09156 NATIONAL TAIWAN UNIV., TAIREI. DEFT. OF AGRICULTURAL CERNISTRY.

HEFECIS OF SALTS AND ORGANIC MATERIALS ON THE HYDRAULIC CONDUCTIVITY OF THE SOILS,

H70-09290 02G NATIONAL WATER WELL ASSOCIATION, COLUMBUS, OHIO.
THE PROTECTION OF GEOUNDWATER RESOURCES.
W70-09127

NAUCHHO ISSLEDOVATELSKII GIDROKHIHICHESKII INSTITUT, NOVCCHEBKASSK (USSB). CHEMICAL CCHFOSITION OF THE ICE OF CTKAZBENSKIY BESERVOIR, H70-09097 BYDROCHEMICAL REGIME AND SALT BALANCE OF OTKAZNENSKIY BESEBVOIR IN THE FIRST YEAR OF ITS EXISTENCE (1966). R70-09058 BICFORLEMENTS IN ATMOSPHERIC PRECIFITATION IN THE CTRAZNEWSKIY BESERVOIR AREA,

028 SELF-PURIFICATION OF NATURAL WATERS FROM CARBOHYDFATES, #70-09100 058 NAUCHNO ISSLEDOVATELSKII GIBBCKHIHICHESKII INSTITUT, NOVOCHERKASSK (USSR) AND ALL-UNION SCIENTIFIC RESEAFCE INST. OF HYDROGEOLOGY AND ENGINEERING GEOLOGY, MOSCCE (USSE).

OKIDATION OF ALCOHOLS AND THEIR INFLUENCE ON THE SELF-PURIFICATION OF NATURAL WATERS,

W70-09101 05B NAUCHHO ISSLEDOVATELSKII GIDROKHIHICHESKII INSTITUT, NOVOCHEFKASSK (USSR). CHEMICAL HYDROLOGY OF REGIONS OF BASI ANTARCTICA, W70-09134 NAVAL OCEANOGRAPHIC OFFICE, WASHINGTON, D.C. CCASTAL OCEANOGRAFRY BRANCH.

ISOPACHOUS MAPPING OF THE LOWER PATUXENT ESTUARY SEDIMENTS: BY CONTINUOUS SEISHIC PROFILING TECHNIQUES, W70-09390 02L NAVAL OCFANGGRAPHIC OFFICE, WASHINGTON, D.C. DEEP VEHICLES PRANCH.

VISUAL CBSERVATIONS OF SUSPENDED-PARTICLE DISTRIBUTION AT
THREE SITES IN THE CARLEPEAN SEA,

02J NEW BRUNSWICK ELECTRIC POWER CONHISSION, PREDERICTON CANADIAN GENERAL ELECTRIC CO., LTD., PETERBOROUGH (OMTARIO) AND GENERAL ELECTRIC CO., SCHEMECTADY, N. T.

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION SOLID STATE—
STATE HYDC ASYNCHRONOUS TIE INSTALLATION,
W70-09012 08C NEW HAMESPIFE UNIV., DURHAM.
DISSOLVED SOLIDS-DISCHARGE RELATIONSHIPS 1. MIXING NEW MEXICO INST. OF MINING AND TECHNOLOGY, SOCORRO.

ELECTROLYTIC MODEL STUDY FOR COLLECTOR WELLS UNDER FIVER BEDS. #70-09210 NEW MEXICO STATE UNIV., UNIVERSITY PARK.
DISPOSAT OF BEINE BY SOLAR EVAPORATION FIELD EXPERIMENTS;
W70-09150 02D NEW MEXICO STATE UNIV., UNIVERSITY PARK. DEPT. OF BICLOGY.
PHYSIOICSICAL RESPONSES TO TEMFERATURE AND DESICCATION IN
THE EMPLHIC MEM MEXICO PLETHODONTIDS, PLETHODON NECHEMICANU
AND AMBIDES HARDIT,
W70-09145 HEART PATE AND CHANGES IN BODY PLUIDS IN AESTIVATING TOADS PACK YESIC HABITATS, #70-09148 NEW YORK OPERATIONS OFFICE (AEC), N.Y. EEALTH AND SAFETY LAB.
STRONTIUM 90 CONCENTRATIONS IN SURPACE AIR
VERSUS ATLANTIC OCEAN FROM 1966 TO 1969,
W70-09229 02B YORK UNIV., BRONK. DEPT. OF METECHCLOGY AND CCEANOGRAPHY.
A STUDY OF HEAT TRANSFER COEFFICIENTS IN THE LOWEST 400 HETERS CF THE ATMOSPHERE, NEWCASTLE UNIV. (AUSTRALIA) AND PROKEN HILL PROPRIETARY CO.
LTD., SEORTLAND (AUSTRALIA).
ON GROLOGICAL AND PECHNOLOGICAL ASPECTS OF ORIENTED N-SIZE
CORF DIJHOND DRILLING,
W70-09028
DBE NORGES TEKNISKE HOEGSKOLE, TRONDHEIM.
USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEEFING,
W70-09029 07B NORTH CAROLINA STATE UNIV., RALEIGH. DEPT. OF MECHANICAL AND ABBOSPACE ENGINEERING.

MEASUREMENT OF THE THERNAL CONDUCTIVITY OF FROST BY A TRANSIENT HOT-WIRE TECHNIQUE,

W70-09233 NORTH CAROLINA STATE UNIV., RALEIGH. SCHOOL OF ENGIFEERING. STUDY OF EROSION IN ROADSIDE DRAINAGE CHANNELS IN NORTH CAROLINA, W70-09455 NORTH CAROLINA WATER RESOURCES RESBARCH INST., RAIEIGE.

FRECEPTINGS WORKSHIP ON MCSQUITO CONTROL IN MORTH CAROLINA, W70-09421 NORTH DAKOTA WATER RESOURCES RESEARCH INST., PARGO.
WATER QUALITY IN RELATION TO PRODUCTIVITY OF LAKE ASHTABULA
RESIZVOIR IN SOUTHEASTERN NORTH DAKOTA,
W70-09093 NORTHERN ARIZONA UNIV., FLAGSTAPP. A REVIEW OF STRESS-STRAIN RELATIONSHIFS FOR CONCEPTE, W70-05032 08P

NORWEGIAN WATER RESOURCES AND ELECTRICITY BOARD, OSLC. EYPEBIENCES WITH SHOW PILLORS IN NORWAY, W70-09375 02C

A SCOTIA TECHNICAL CCLL., HALIFAX.
GE AND COLCE REMOVAL FROM KRAFT MILL WASTES,
70-09330 OSD

T SAC UNIV. (YUGOSIAVIA). FACULTY OF AGRICULTUBE.
UNFLUENCE OF SCII STRUCTURE ON INFILTRATION AND PF VALUES OF
HERNOZEM AND CHEENCZEMIIKE DARK MEADON SOILS,
170-09254

R RIDGE KATICHAI LAE., TENN. DRY LANCS AND DESALTED WATER, 470-09030

SPACE HEATING IN UREAN ENVIRONMENTS, #70-09152 CSES OF WASTE HEAT, W70-09193

FICE OF SALINE WATER, WASHINGTON, D.C. DISTILLATION DIGEST VCIUMES 1 AND 2. W70-09360 03A

IC STATE UNIY., COLUMBUS. DEFT. OF AGRICULTURAL AGRICULTURAL AGRICULTURAL WASTES AND THE ENVIRONMENT, W70-09458

AYARA UNIV. (JAFAN). OHARA INST. RELATION BETWEEN THE "TTAI-TTAI" DISEASE AND THE POLLUTION CF FIVES WATER BY CAUBIUP FECE A BINE, W70-09427 05C

COMPOSITATE UNIV., STILLWATER. EICENGINEPRING LABS.
CONTROL NECHANISHS OFERNATIVE IN A NATURAL MICROEIAL
FOPULARICH SELECTED FOR ITS ABILITY TO DEGRADE L-LYSINE, II.
FFFICIS OF FRUCIOSE AND RIECSE IN PATCE SYSTEMS,
W70-09336

CONTROL MECHANISMS OPERATIVE IN A NATURAL MICROBIAL FOULATION STRECTED FOR ITS ABILITY TO DEGRADE L-LYSINE, III. EFFECTS OF CARFORVERATES IN CONTINUOUS-FLOW SYSTEMS UNDER SHOCK LCAD CONDITIONS, 95D

KIAHCHA STATE UNIV., STILLWATER. RESERVCIR BESEARCH EXPERIMENTS ON THE ACSORPTION OF AMMONIUM IONS BY CLAY FABRICLES IS NATURAL WATERS, W70-09211 02K

NATUR D'ASSAINISSEMENT, PARIS (FRANCE). AUTOMATED ACTIVATED SLUDGE PLANTS WITE RESPIRATORY RETARCLISM CONTROL, W70-09562 05D

NTABLE WATER RESCUECES COMMISSION, TOPONIC. WATER QUALITY UNIVERSE FRANCE.
LISPERSION EREDICTION FROM CURRENT METERS,
N70-09219 02E

ACIFIC TELEFECHE AND TELEGRAFH CO., PASALENA, CALIF. AND TREBAL TELEFONE CO. OF CALIFORNIA, SANTA HONICA.

1969 HVDC STRAY CURRENT TESTS ON UNDERGROUND TRIFFECHE CABLES,
W7C-05015

08C

ABLAVI UNIV., SEIRAZ (IRAB). CEAGACTERISTICS OF WASTEWATER AT DELHI, W7C-09327 05D

ALE FEACE COUNTY AREA PLANNING BOARD, WEST PALE SEACH, PLA.
COMPREHENSIVE WATER SUPPLY, SEWERAGE, SOLID WASTE AND AIR
ECILUTICS CONTECT FLANS,
W70-09450
06B

PENSYLVANIA STATE UNIV., UNIVERSITY PARK. INST. FOR SEARCE ON LAND HATER RESCURCES.

FLOOD SERIES FOR GAGED PENNSYLVANIA STREAMS, 02E

PHILCC-FOFD CORP., NEWPORT BEACH, CALIF.

ABEROVEHENT OF TUBULAR CELLULOSE ACETATE MEMBRANES BY FEED

ACCULATES,

870-C9248

PLANNING BESTARCE CORP., HCLEAR, VA.

A METHOD FOR THE EVALUATION OF THE SYSTEM AND COST

EFFECTIVENESS OF LABGE SEA WATER DISTILLATION PLANTS,

870-09247

PRIKCETON UBIV., N.J. EEPT. OF CHEMISTRY. A EONDING MODEL FOR ANOMALOUS WATER, N70-09126 01A

PUNJAF AGEICUITUBAL UHIV., HISSAB (INDIA), BYDBAULIC DISIGN FOR CHECK METHOD OF IRRIGATION, 870-09136

PERCUE UNIV., INFAVETIE, IND.
CFTIMAL BESCURCE ALLOCATION AND SOME TECHNIQUES OF
CFTIMIZATION,
W70-09182

A KINETIC AND EQUILIBRIUM STUDY OF THE ADSCRIPTION OF THE OFGANIC INSECTICIDES CAREARYL AND PARATHION UPON SOME SOIL OFGANIC HATTER SURFACES, 05A

PUBLUE UNIV., LAFAYETTE, IND. DEFT. OF AEBONAUTICS, ASTRONAUTICS, AND ENGINEERING SCIENCES.

ON THE SYSTEMS APPROACH IN HYDROLOGY, 02A

PURDUE UNIV., LAPAYETTE, IND. DEPT. CF AGRONOMY.

OESERVATIONS ON ACTIVITY AND DIFFUSION COEFFICIENTS IN NAHONTHCEILLONITE,

PURDUE UNIV., LAFAYETTE, IND. WATER RESOURCES RESEAFCH CENTER.

AN APPROXIMATE METHOD FOR DETERMINING THE HYDRAULIC CONDUCTIVITY FUNCTION OF UNSATURATED SOIL, W70-09342

QUEEN'S UNIV., KINGSTON (ONTARIO). DEFT. OF BICLOGY.
THE TEMFERATURE SELECTION OF SMALL HYPOPHYSECTONIZED
GOLDFISH, (CARASSIUS AURATUS L.),
W70-09151 05c

REGIONAL INST. OF TECH., JAMSHEDPUR (INCLA).

EFFECT OF RECIRCULATION ON DEEP TRICKLING FILTER
PERFORMANCE,

RESEARCH COUNCIL OF ALBERTA, EDMONTON.
INTEGRATION OF GEOPHYSICAL METHODS FOR GROUNDRATER
EXPLICATION IN THE PRAIRIE PROVINCES, CANADA,
078

RESEARCH INST. FOR WATER RESOURCES DEVELOPMENT, BUDAFEST (HUNGARY).

REDUCTION OF SEEPAGE LOSSES FROM IBBIGATION CANALS AS A RESULT OF SILTING,
870-09043

03P

TIDAL PRENOMENA IN THE KARSTIC WATER LEVEL, W70-09368

RICE (CYBUS NM.) AND CO., PITTSBURGE, PA. WATER TECHNOLOGY, W70-09361 0

RIJKSFACULTEIT DER LANDHOUWWETENSCHAFFEN, GHENT (BEIGIUM). COMPARATIVE STUDY OF THE WATER BALANCE IN THE ABRATED ZONES WITH RADIO-ACTIVITE METHODS AND WEIGHABLE IYSIMETEF, W70-09263 02G

ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, WATERSHED HUMAN-USE LEVEL AND WATER CUALITY, W70-09240

DEGRADATION OF WASTE WATER ORGANICS IN SOIL, W70-09329

ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCES, MIAMI, HEAT WASTE, W70-09162

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN (ENGLAND).
THE ROLE OF VEGETATION IN SOIL WATER PROBLEMS,
W70-09262 021

WATER TRANSPORT IN SOILS BY EVAPORATION AND INFILITATION, W70-09276 02D

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N.J. WATER RESOURCES RESEARCH INST. BOD MASS GALANCE AND WATER QUALITY STANDARDS, W70-09349

SACRAMENTO REGIONAL AREA PLANNING COMMISSION, CALIF.
PRELIMINARY WATER AND WASTE MANAGEMENT PLAN.
W70-09453 05D

SAN JOSE-SANTA CLARA WATER POLLUTION CONTROL PLANT, SAN JOSE, CALIF.
REDUCING WASTE ACTIVATED SLUDGE VOLUME BY ANEROBICSIS,
W70-09187
05D

SASKATCHENAN UNIV., SASKATOON.
A REVIEW OF SOME PROBLEMS OF SEISHIC PROSPECTING FOR
GROUNDWATER IN SURFICIAL DEPOSITS,

ASKATCHENAN UNIV., SASKATOON. DEPT. OF AGRICULTURAL SANATURERING.
ON USING A TIME VARIABLE INFILIRATION WITH THE ISBAELSON BORDER IRRIGATION EQUATION, 03F

SASKATCHEMAN UNIV., SASKATOON. DEPT. OF SOIL SCIENCE.
EFFECT OF SOIL PROFILE TYPE AND PERTILIZER ON MOISTURE USE
BY UBEAT GROWN ON FALLOW OR STUBBLE IAND,
W70-05139

SCET/CCOPERATION-BCA, PUTEAUX (FRANCE).
ON THE SOLUTION OF INVERSE PROBLEMS IN HYDROGEOLOGY
(FRENCH),
W70-09371
02F

SCRIPPS INSTITUTION OF OCEANOGRAPHY, IA JOLLA, CALIF.
HOIRS ON A THEORY OF THE THERMOCLINE,
W70-09191

SOUTH CAROLINA UNITA, COLUMBIA.

STEPAH CROER AS A MEASURE OF SAMPLE SCURCE UNCERTAINTY,
W70-09202 02J

SOUTHERN CALIFORNIA EDISON CO., LOS ANGELES AND GENERAL

W70-09116

SIFCTRIC CC. FITTSFIELD, MASS.
SMITCBING-SURGE CONSIDERATIONS IN UNIT TRANSMISSION LINE
LESION,

SOUTHERN CALIFORNIA EDISON CO., LOS ANGELES. DEPT. OF MECHANICAL ENCINEERING.

EFFECTS OF THERMAL DISCHARGE FROM THE SAN ONOFRE NUCLEAR GENERATING STATICN,

W10-09165

SOUTHERN CALIFORNIA METROPOLITAN WATER DISTRICT, LCS
ANCELES.
CRCSSING THE SIERRA MADRE FAULT ZONE IN THE GLENDORA TUNNEL,
SAN GABSIEL MCUNTAINS, CALIFORNIA,
W70-09051 08E

SCUTHWEST RESEARCH INST., BCOSTON, TEX. LESALTING COST CALCULATING PROCEDURES, W70-09241 037

STANFORD UNIV., CALIF.
THE OPTIMIZATION OF STORM-HOLDING TANKS A FROBLEF CF WATER ECITUTICS CONTECT, W70-09181 05G

A HOVING BOUNDARY HODEL OF A ONE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIERT PCROUS FLOW SYSTEM, W7C-09199 02G

STATE COLL. OF AGRONOMICAL SCIENCES, GEMBLOUX (BELGIUM).
DIVERGENCES BETWEEN EXPERIMENTAL AND THEORETICAL VALUES OF
CAPILLABY DIFFUSIVITY (FRENCE),
W70-09285
02G

STATE UNIV. OF NEW YORK, STONY BROOK. MARINE SCIENCES BESSANCE CENTER. NEW YORK BETROFCLITAN REGION--A MAJOR SECTIMENT SCURCE, \$70-09203

SWEDISH METEOSOLOGICAL AND HYDROLOGICAL INST., STOCKHOLM (SMEDEN).
AN INSTRUMENT FOR MEASURING SOIL MOISTURE BY NEUTRON SCATTERING,
870-05265
07E

SYFACUSE UNIV., N.I.
FAFFLED BIOLOGICAL PASIS FOR IRRATING POULTRY PLANT WASTES, \$70-09320 05D

TAYLOR ROODECH CONSTRUCTION LTD. SOUTBALL (ENGLAND).
FOUNDATION SETTLEMENT AND GROUND REACTION CALCULATIONS USING
A DIGITAL COMPUTER,
N7J-09036

TECHNION - ISHAEL INST. OF TECH., HAIFA AND CALIFCRNIA UNIX., BEFKELEY.

SCLUTIONS OF THE NON-LINEAR DIFFUSION EQUATION WITH A CRAVITY TERM IN HIDROLOGY, W70-05308

02G

TECHNISCHE HOCHSCHULE, MUNICH (WEST GERMANY).
ABOUT THE ROUGHNESS PROBLEM IN PIPES AND TUNNELS,
\$70-09011 98F

BYDROLOGICAL SERIES AS A BASIS FOR BATER RESOURCES FOLICY, 870-09387

TENNESSEE VALLEY AUTHORITY, KNOAVILLE. FIGCD CAMAGE FREVENTION. W70-09364

TEXAS A AND M UNIV., COLLEGE STATION AND FLORIDA UNIV., GAINESVILIE.

EFFECTS OF BAINFALL ON SETTLING VELOCITY OF SUSPENDED SEDIMENT IN QUIESCENT WATER,

#70-09120 02J

TEIAS A AND B UBIV., COLLEGE STATION. WATER RESOURCES INST.
APPLICATION OF SPECIALIZED OPTIMIZATION TECHNIQUES FOR WATER
CUALITY AND QUANTITY HANAGEMENT WITH RESPECT TO FIANNING FOF
THE TRIBLITY BIVER BASIN,
670-09054

TEXAS TRANSPOSTATION INST., COLLEGE STATION. EFOSICH CONTROL ON FCADSILES IN TEXAS, W70-09451 02J

TEXAS UNIV., ARLINGTON. DEPT. OF BIOLOGY.
THE STABILITY OF WHEAT EMBRYO GLUTAMATE DECARBOXYLASE UNDER CONDITIONS OF WATER STRESS, NO. 27

TEXAS UNIV., AUSTIN. ENVIRONMENTAL HEALTH ENGINEERING RESEARCH LAE. ABIONIC AND MONIONIC SURFACTANT SORPTION AND DEGRADATION BY ALGAE CUITIEES. W70-09458

THE WATER RESTARCH ASSOCIATION, MEDMENHAM (ENGLAND).

MEASURING SCIL MOISTUBE IN THE BRENIG CATCHMENT PROBLEMS
OF USING MEDTHON SCATTER EQUIPMENT IN SOIL WITH FRATY
LAYERS,
W70-09264

02G

TOBERTO UNIV. (ORTABLE).

A THE-STEP FROBABILISTIC MODEL OF STORAGE RESERVOIR WITH CORRELATED INCUTS,

UNITED NATIONS, NEW YORK.

GEOPHYSICS IN UNITED NATIONS PROJECTS,
W70-09397 07B

UNITED STATES LAKE SURVEY, DETROIT, MICE.
COLOR-VELCCITY METHOD IN MEASURING DISCHARGE,
W70-09449 07B

UNIVERSAL WATER CORP., DEI MAR, CALIF.
DEVELORMENT OF REVERSE OSMOSIS MEMERANES,
W70-09362 03A

UNIVERSITY COLL. OF MALES, ABERYSTWITH. DEPT. OF BCTANY.
TOXICITY STUDIES WITH AN OIL-SPILL EMULSIFIER AND THE GREEN
ALGA PRASINOCLADUS MARINUS,
W70-09429
05C

UNIVERSITY OF EAST ANGLIA, NORMICH (ENGIAND). SCHOOL OF ENVIRONMENTAL SCIENCES. DEPOSITION OF FINE-GRAINED SUSPENDED SEDIMENT FROM TIDAL CUBERNTS, W70-09732

UTAH STATE UNIV., LOGAN. DEPT. OF CIVIL ENGINEERING.
EFFECTS OF EPFLUENT AND INFLUENT SEFFAGE ON THE HYDRODYNAMP
PORCES ACTING ON AN IDEALIZED NONCOHESIVE SEMINENT PARTICLE
W70-09410

UTAH STATE UNIV., LOGAN. DEPT. OF SOILS AND METEORCICGY.
A PREDICTION EQUATION FOR VEGETATION EFFECTS ON WATER YIELD
FROM WATERSHEDS IN ARID AREAS,
03B

VAN-BOTF-HARVEY ASSOCIATES, PRINCETON, N. J. APRATED LAGOONS TREAT SECONDARY EFFLUENT, W70-09331 05D

VIRGINIA INST OF MARINE SCIENCE, GLOUCESTER POINT. COASTAL WETLANDS OF VIRGINIA-INTERIM REPORT, W70-C9350 021

VSESOYUZNAYA AKADEMIYA SELSKOKHOZYAISTVENNYKH NAUK, BOSCOW (USSR).
THE NATURE OF THE MINIMAL WATER RETENTIVE CAPACITY, W70-09302 02G

WASHINGTON STATE UNIV., PULLMAN.
TREATMENT OF DAIRY MANURE BY LAGOONING,
W70-09335 05D

WASHINGTON STATE WATER RESEARCH CENTER, PULLMAN.
PACTORS AFFECTING THE MOVEMENT OF WATER AND ORGANISMS WITHIN
A TO-09090 02H

PATER FLANNING FOR ISRAEL LTD., TEL-AVIV.
INTEGRATION OF GEOPHYSICS AND HYDROGECLOGY IN THE SOLUTION
OF RECICNAL GROUNDWATER PROBLEMS,
W70-09404
07B

WATER FOLLUTION RESPARCH LAB., STEVENAGE (ENGLAND).
EFFECT OF TOXIC WASTES ON TREATMENT PROCESSES AND
WATERCOURSES,
W70-02/34

WATER RESCURCES BOARD, BEADING (ENGLAND).
PLANNING OUR FUTURE WATER RESOURCES,
W70-09153
068

WATER RESOURCES ENGINEERS, INC., WALNUT CREEK, CALIF. ECONOMICS OF CANNERY WASTE TREATMENT, 05D

WATERLOOPHUNDIG LABORATORIUM, DELFT (NETHERLANDS).
TWO IAYER MODEL OF STRATIFIED FLOW IN AN ESTUARY,
W70-09152 02L

WAYNE STATE UNIV., DETROIT, HICH.
FILTRATION OF WASTE PLANT EFFLUENTS,
W70-09317 OSD

WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.
FINAL REPORT OW REVERSE OSMOSIS MEMBRANES CONTAINING
GRAPHITIC OXIDE,
W70-09245
03a

WISCONSIN UNIV., HADISON.

POST-IRRIGATION HOVEHENT OF SOIL WATER 1. REDISTRIBUTION,
W70-09124 020

A STUDY OF PARM WASTE, FARM ANIMAL WASTE CHARACTERIZATION, BANDLING, UTILIZATION, W70-09426 05B

WISCONSIN UNIV., MADISON. WATER RESCURCES CENTER.
WITRATE VARIATION IN GROUNDWATER,
W70-09425 05A

WORLD HEALTH ORGANIZATION, ALEXANDRIA (EGYPT).
COMPARATIVE STUDIES OF THE HOLLUSCICIDAL EFFECT OF CUPROUS
CHLORIDE AND COPPER SULFATE IN IRAN,
W70-09432

ZINN (H.V.) AND ASSOCIATION (GREAT ERITAIN).
DETAILING BY COMPUTER,
N70-09035 08P

ACCESSION NUMBER INDEX

E	W70-09011	7.7	W70-09084	06E	W70-09157	02K	W70-09230
C	W70-09012		w70-09085	06E	W70-09158	02J 02L	W70-09231 W70-09232
B C	W70-09013		W70-09086	06E 05C	₩70-09159 ₩70-09160	0 2C	W70-09233
3 C	W70-09014	0 áE	W7C-09037	05C 05B	W70-09160	02E	W70-09234
BC	W70-09015	CGE	W70-09088	05B	W70-09162	02L	W70-09235
BC .	W70-09016	06E	W70-09089	06E	W70-05163	05D	W70-09236
e C	W7C-09C17	0 2 H	W70-09090	06E	W70-09164	02F	w70-09237
B C	W70-09018	C5F	W70-09091 W70-09092	05C	W70-09165	0 2 B	W70-09238
8 F 6B	W70-09019 W70-09020	06A 5C	W70-09092	05C	W70-09166	02J	W70-09239
		05G	W70-09094	08C ·	W70-09167	05B	W70-09240
8 C 8 E	W70-09021 W70-09022	03G 02K	W70-09095	05B	W70-09168	03A	W70-09241
8C	W70-09023	0 2 D	W70-09096	06E	W70-09169	06E	W70-09242
2J	W70-09024	02K	W70-09097	05C	W70-09170	06E	W70-09243
3D	W70-09025	02K	W70-09098	05A	W70-C9171	03A	W70-09244
2J	#70-09026	02B	W70-09099	0.5G	W70-09172	03A	W70-09245 W70-09246
2E	W70-09027	05E	W70-09100	08B	W70-09173	03A 03A	W70-09247
E E	W70-09028	05E	W70-09101	06E	W70-09174	03A	W70-09248
7B	W70-09029	02E	W70-09102	06E	W70-09175 W70-09176	02F	W70-09249
3 C	W70-09030	C2F	W70-09103	02A	W/0-03170		
8E	W70-09031	02C	W70-09104	08B	W70-09177 W70-09178	02H 02K	W70-09250 W70-09251
8F	W70-09032	02K	W70-09105	08B 02L	W70-09178	04A	W70-09252
8F	W70-09033	02B	W70-09106	02L 08B	₩70-09179 ₩70-09180	06F	W70-09253
8 C	W70-09034	02F	¥70-09107	05G	W70-09181	0 2 E	W70-09254
8F	W70-09035	02K	W70-09108 W70-09109	05G	W70-05182	06F	W70-09255
8D	W70-09036	06A	W70-09109	06C	¥70-09183	02J	W70-09256
5F	W70-09037	06A 02D	W70-09111	05A	W70-09184	02C	W70-09257
8C	W70-09038	C 2D	W70-09112	08A	W70-09185	0 3C	#70+09258
8C 8G	W70-09039 W70-09040	02D	W70-09113	05D	W70-09186	06B	W70-09259
.5.	1150 000/14	02C	w70-09114	05D	W70-09187	0 2 F	W70-09260
55 D	W70-09041	06A	W70-09115	06B	W70-09188	0 2G	W70-09261 W70-09262
)4A)3F	W70-09043	CGA	W70-09116	05C	W70-09189	021	W70-09263
08D	H70-09044	C3E	W70-09117	05D	W70-09190	0 2G 0 2G	W70-09264
181	W70-09045	02J	W70-09118	05B	W70-09191	07B	¥70-09265
2F	W70-09046	02 J	W70-09119	08C	W70-09192 W70-09193	02G	W70-09266
)8C	W70-09047	02J	W70-09120	03C	W70-09194	07B	W70-09267
06G	W70-09048	02J	W70-09121	05B 02G	W70-09195	07B	W70-09268
04 A	W70-09049	05A	W70-09122	02G 02L	W70-09196	07E	W70-09269
04A	w70-09050	U2F	W70-09123			070	w70-09270
04A	W70-09051	0 2 G	W70-09124	02F	W70-09197	07B 07B	W70-09270
02J	W70-09052	0 1A	W70-09125	02G	W70-09198	07B	W70-09272
06E	W70-09053	0 1 A	W70-09126	02G	W70-09199	C7B	W70-09273
06 E	W70-09054	02F	W70-09127	02F 02F	W70-09200 W70-09201	07E	W70-09274
06E	W70-09055	02K	W70-09128	02F 02J	#70-09201	07B	W70-09275
05G	w70-09056	04C	W70-09129	02J	W70-09203	02D	
C6E	W70-09057	02E	W70-09130	07C	W70-09204	0 7 B	
06 E	W70-09C58	C6E	W70-09131 W70-09132	02D	W70-09205	07E	
06E	W70-09059	02E 02E	W70-09132	02H	W70-09206	02G	w70-09279
06E	₩70-09060	V2 L		A C A	W70-09207	0 2 G	W70-09280
06E	¥70-09061	02K	W70-09134	03B 02E	W70-09207	07E	W70-09281
CEE	W70-09062	021	W70-09135	02E	W70-09209	02G	W70-09282
06 E	W70-09063	03F	W70-09136	02F	W70-09210	0 2 G	
CGE	W70-09064	021	W70-09137 W70-09138	02K	W70-09211	02F	
06E	W70-09065	021	W70-09136	07B	W70-09212	0 2 G	
06E	W70-09066	03F 03C	w7.0-09140	02K	W70-09213	026	
06 E	W70-09067	03F	W70-09140	02F	W70-09214	0 2 G	
C6E	W70-09068	06E	W70-09142	0.5G	W70-09215	020	
C6E	W70-09069 W70-09070	04A	w70-09143	02L	w70-09216	0.26	
		0.07	W70-09144	02L	W70-09217	029	
06 E	W70+09071	02I 02I	W70-09145	02E	W70-09218	0 2 9	
06E	W70-09072	02G	W70-09146	02E	W70-09219	0.20	
06E	N70-09073 N70-09074	021	W70-09147	04A	W70-09220	020	
C6E	H70-09074	021	W70-09148	04A	W70-09221	0 20	
06E	W70-09076	021	W70-09149	04A	W70-09222 W70-09223	0 20	w70-09296
06E	n70-09077	02D	W70-09150	02F 02B	W70-09223	071	3 W70-09297
06E	W70-05078	05C	W70-09151	02E 02F	W70-09225	0.20	
06E	W70-09079	02L	W70-09152	02F 02F	W70-09226	0.20	W70-09299
06E	W70-09080	06B	W70-09153			0.20	3 W70-09300
C6E	W70-09081	C4A	W70-09154	02F 05G		020	W70-09301
COE	W70-09082	06C	W70-09155	0 2 B		0.20	g W70-09302
06E	W70-05083	02B	₩70-09156	UZD			
2011							

ACCESSION NUMBER INDEX

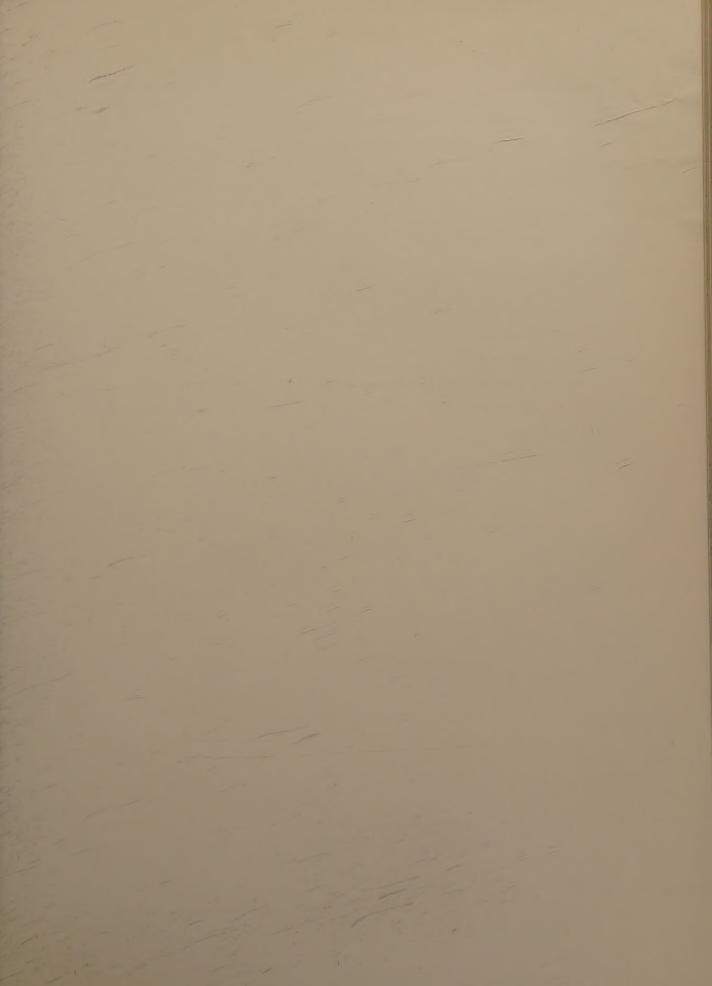
						06E	W70-09455
02G	w70-09303	06E	W70-09355	07B	W70-09407	06E	W70-09466
C2G	¥70-09304	AEO	W70-09356	07B	W70-094C8		W70-09466
	W70-09305	OBA	¥70~09357	07B	W70-09409	06E	
02G		AEO	W70-09358	08B	₩70-09410	04A	W70-09466
02G	w70-09306			02F	W70-09411	06E	W70-09466
02G	W70-09307	03A	W70-09359	02C	W70-09412	04A	W70-09466
026	W70-09368	03A	W70-09360		W70-05412	06E	W70-09466 A
02G	#7C-09309	CBA	¥70-09361	0 2 D		04A	W70-09466
0 2 G	w70-09310	03A	W70-09362	02J	W70-09414		
	¥70-09311	03A	W70-09363	04A	#70-09415	06E	W70-09466
C2K		10	N70-09364	02J	¥70-09416	06E	W70-09466
0 2 J	W70-09312	10	W70-0331.4				_
				02J	W70-09417	06E	W70-09466
026	₩70-09313	04A	W70-09365		w70-09418	06E	W70-09477
02H	W70-09314	06F	W70-09365	02J		04A	W70-09477
C2J	W70-09315	02F	W70-09367	02K	w70-09419		W70-09477
050	W70-09316	02F	W70-09368	02E	¥7C-05420	03F	
CSE	W70-09317	06B	W70-09369	06G	W70-09421	04A	W70-09477
		03B	W70-6937C	05B	W70-09422	06E	W70-09477
05E	W70-09318		W70-09371	05D	W70-09423	06E	W70-09477
050	₩70-09319	02F		05B	W70-C9424	04A	W70-09470 3
050	W70-09320	04D	W70-09372		W70-09425	06E	W70-09477
05D	W70-09321	02F	W70-09373	05A			W70-05477
CSD	W70-09322	02E	w70-09374	05B	W70-09426	06E	# 70-09474
C6E	W70-09323	02C	W70-09375	05C	₩70-09427	06E	W70-09479
05D	N70-09324	10	¥70-09376	05C	W70-C9428	03F	W70-09488
		02G	W70-09377	05C	W70-09429	06E	#70-09483 b
050	W70-09325			05C	W70-09430	04A	W70-09483
050	W70-09326	02G	W70-09378			04A	W70-09483
CSD	₩70~09327	02G	W70-09379	05C	W70-09431		W70-09486
CSD	W70-G9328	02G	W70-09380	05C	W70-09432	05G	
05E	W70-09329	03B	W70-09381	05A	W70-09433	05B	W70-09485
CSD	W70-09330	02G	W70-09382	05C	ir70-09434	04A	#70-09486 -
05D	¥70-09331	05€	W70-09383	05C	W70-09435	04A	W70-09483
		0 2 G	W70-09384	0.5C	W70-09436	04A	W70-09488
C5D	₩70-09332	0 2 G	W70-09384	0.50	#10 03430	0 4 88	
				0.5C	W70-09437	06E	W70-094899
050	W70-09333	02A	W70-09385				W70-09489
05D	W70-09334	02F	W70-09386	05C	w70-09438	045	
05E	W70-09335	06A	W70-09387	06B	¥70-09439	06E	W70-09491
C5D	W70-09336	05C	W70-09388	06E	¥70-09440	04A	W70-09492
05D	W70-09337	09C	W70-09389	09A	W70-09441	04A	W70-09493
05E	w70-09338	021	W70-C939C	07B	W70-39442	0 4 A	W70-09494
05D	W70-09339	07C	W70-09391	06E	W70-09443	048	W70-09495
		07E	W70-09392	06E	W70-09444	04A	W70-094964
05D	W70-09340						W70-094971
050	W70-09341	07B	W70-09393	08A	W70-09445	03E	
0.2G	W70-09342	07B	W70-09394	05D	W70-09446	05B	W70-09498
C6E	670-C5343	07E	W70-09395	08H	W70-09447	0 5 G	W70-09499
06G	W70-09344	07B	W70-09396	06G	W70-09443	06E	W70-095000
C2G	W70-09345	07E	W70-09397	07B	W70-09449	03F	W70-095011
021	W70-09346	07B	W70-09398	06B	W70-09450	05D	W70-095022
05G	¥70-09347	07E	W70-09399		#70-09451		#70-095033
				02J		05D	
CSA	W70-09348	07F	W70-09400	08D	W70-69452	05D	W70-095044
05A	W70-09349	07B	W70-09401	05D	W70-09453	05D	W70-095055
02L	W70-09350	07B	W70-09402	07E	W7C-C5454	05D	W70-095066
C2C	W70~09351	07E	W70-09403	04A	W70-09455	05D	W70-055C77
CZF	W70-09352	07E	W70-09404	0 2B	W70-09456	05D	W70-095088
		4.2		025	2.3.03430	0.30	#10-03366G
C7A	W70-09353	07E	W70-09405	OCE	270 00457	050	1170 05560
				06E	W70-09457	05D	W70-095099
AE0	W70-09354	07B	W70-09406	04A	W70-09458	05D	W70-095100

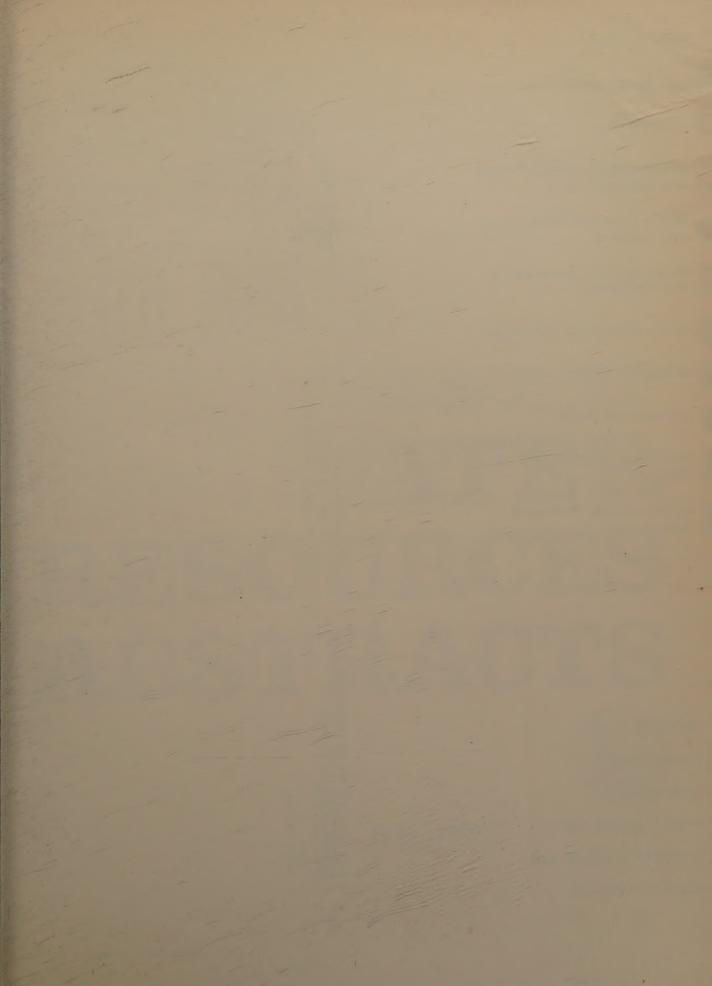
ABSTRACT SOURCES

o u r	ce	Accession Number	Total
٠.	Center of Competence		
	U.S. Geological Survey - Hydrology	W70-0909609134 0919409241 0924409254 0925509258 0926009315 0934709419	232
	University of Texas - Wastewater Treatment and Management	W70-0931609322 0932409341 0950209510	34
	Bureau of Reclamation - Engineering Works	W70-0901109024 0902609050 09052	40
	University of Arizona - Arid Lands Water Resources	W70-0913509141 0914409149	13
	Vanderbilt University - Thermal Pollution	W70-0915109153 0915609157 09158, 0916009162 0916509168 0917009173	16
	University of Washington - Water Quality Requirements for Aquatic Organisms	W70-0942709438	12
	University of Chicago - Metropolitan Water Resources Management	W70-0943909444	6
	Rutgers The State University - Water Resources Economics	W70-0949709499 09501	4
	University of Florida - Eastern U.S. Water Law	W70-0905309089 0945709496 09025,09051 09142,09143 09154,09155 09157,09159 09163,09164 09169,09174 09175,09242 09243,09323 09343,09355	96
В.	State Water Resources Research Institutes		
	Washington Water Research Center	W70-09090	1
	Georgia Environmental Resources Center	W70-09091	1
	Kansas Water Resources Research Institute	W70-09092	1
	North Dakota Water Resources Research Institute	W70-09093	1
	Texas Water Resources Institute	W70-09094	1

ABSTRACT SOURCES

Sou	rce	Accession Number	Total
В.	State Water Resources Research Institutes (Cont'd)		
	Mississippi Water Resources Research Institute	W70-09095, 09259 09345, 09346	4
	Indiana Water Resources Research Center	W70-0918/2, 09184 09342	3
	South Carolina Water Resources Research Institute	W70-09183	1
	Arkansas Water Resources Research Center	W70-09344	1
c.	Other		
	Herbert G. Poertner - Engineering Aspects of Urban Water Resources	W70-0918509193	9
	Corps of Engineers	W70-0917609180	5
	Office of Saline Water	W70-09150	1
	Environmental Technical Applications Center	W70-09456	1
	Stanford University	W70-09181	1





Subject Fields

- NATURE OF WATER
- WATER CYCLE
 - WATER SUPPLY AUGMENTATION AND CONSERVATION
 - WATER QUANTITY MANAGEMENT AND CONTROL
 - WATER QUALITY MANAGEMENT AND PROTECTION
 - WATER RESOURCES PLANNING
 - **RESOURCES DATA**
 - **ENGINEERING WORKS**
 - MANPOWER, GRANTS, AND **FACILITIES**
 - SCIENTIFIC AND TECHNICAL **INFORMATION**

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES



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